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WATER QUALITY PRE-INVESTMENT STUDIES IN THE HORNAD BASIN IN SLOVAKIA

Prepared for the Europe Bureau,
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by

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PREFACE

This basin report describes one of four pre-investment studies WASH has prepared on four river basins tributary to the Danube River: the Yantra basin in Bulgaria, the Sajo-Hernad basin in Hungary, the Arges basin in Romania, and the Hornad basin in Slovakia. The purpose of the studies is to identify wastewater pollution control projects for municipalities and industries within the aforementioned Danube River basins.

The studies were conducted from September 1992 through May 1993 by two teams of three people each. The three members of the team that prepared the Sajo-Hernad and Hornad basin reports are Jim McCullough, team leader and financial specialist; Dave Horsefield, municipal wastewater specialist; and Tarik Pekin, industrial wastewater specialist.

Local support and technical assistance to the WASH team in Slovakia was provided under a WASH subcontract by Drako and Associates of Bratislava. The Slovakia study was carried out in coordination with another USAID project, the Center for Clean Air Policy program. Funding and coordination of the four WASH pre-investment studies were provided by the Europe Bureau of USAID.

The purpose of this report is to summarize the WASH pre-investment study on the Hornad River basin, which includes a prefeasibility study to improve water quality in the Hornad River from Krompachy to the Ruzin Reservoir.

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ACRONYMS

A.I.D.	U.S. Agency for International Development (Washington)
A.I.D./EUR/DR/ENR	A.I.D.'s Bureau for Europe, Office of Development Resources, Environment and Natural Resources
BOD	biochemical oxygen demand
BOD_5	five-day biochemical oxygen demand
CCAP	Center for Clean Air Policy (Slovakia)
COD	chemical oxygen demand
CSO	combined sewer overflows
DEMDESS	Danube Emissions Management Decision Support System
DO	dissolved oxygen
EBRD	European Bank for Reconstruction and Development
EC PHARE	European Community/Poland-Hungary Aid for Restructuring of Economies
EIB	European Investment Bank
ELI	Environmental Law Institute
EPA	Environmental Protection Agency (United States)
EPDRB	Environmental Program for the Danube River Basin
ETP	Environmental Training Project
EVR	North Hungarian Regional Water Works
GIS	geographic information systems
GPA	groundwater protection area
IBRD	International Bank for Reconstruction and Development (division of World Bank)
LEM	Local Environmental Management Project
LIC	Laboratory and Information Center
MFW	Ministry of Forests and Water
MOE	Ministry of Environment

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MSM	Ministry of Soil Management
NGO	nongovernmental organization
OECD	Organization for Economic Cooperation and Development
PBaH	Bodrog-Hornad River Basin Authority
PCU	Program Coordination Unit
RTI	Research Triangle Institute
SEZ	Slovak Electrotechnical Enterprise
SS	suspended solids
TDS	total dissolved solids
TSS	total suspended solids
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
USAID	U.S. Agency for International Development (overseas missions)
VSZ	East Slovakian Iron Works
VVAK	East Slovakian Water Works Authority
WASH	Water and Sanitation for Health (Project)
WEC	World Environment Center
WHO	World Health Organization
WWTP	wastewater treatment plant

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UNITS

cmd	cubic meters per day
cu m, m^3	cubic meters
cu m/sec	cubic meters per second
dca	decare; 1,000 square meters or 0.1 hectares
g	grams
ha	hectares
Kcs*	crown
kg	kilograms
km	kilometers
L	liters
mg	milligrams
ml	milliliter
s, sec	second
sq km, km^2	square kilometers
t	metric tons; 1,000 kg

* On January 1, 1993, the currencies of the Czech and Slovak republics split. In April 1993, the Slovakian monetary unit was renamed the Slovak crown (Sk). Although this report refers to the former unit, Kcs, the values indicated are current.

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EXECUTIVE SUMMARY

Study Scope

This pre-investment study was carried out by the Water and Sanitation for Health (WASH) Project under contract to the U.S. Agency for International Development (USAID) from October 1992 through April 1993. The purpose of the study was to identify high-priority investment projects for wastewater pollution abatement in the Hornad River basin as part of the multi-country Danube River Basin Environmental Program. In addition, the study is intended to help accelerate action in the investment program by taking one of the high-priority projects through the prefeasibility stage.

The study was initiated with an intensive analysis of water pollution problems in the Hornad basin, using existing data sources. Data were assembled from many sources within Slovakia, notably the local river basin and waterworks authorities, municipal governments, local and national environmental offices, specialized water research organizations, and national ministries. Analysis of this data produced an identification of potential projects, which the WASH team ranked by priority after close consultation with central and local government officials. The WASH team then carried out a prefeasibility study on one of the high-priority projects: remediating wastewater pollution problems in the industrial city of Krompachy.

Summary Analysis

Two overriding issues determine the potential for effective water-quality improvements in the Hornad basin. The first is the long-term contamination from mining and ore processing in the central part of the basin, centered on Krompachy and the upstream mining areas. The second is the poor state of municipal wastewater treatment in every major town and city in the basin.

Long-term pollution from mining and ore processing waste in the area from Rudnany to the Ruzin Reservoir below Krompachy (mainly heavy-metal sediments) has rendered this stretch of the Hornad River unusable for drinking water supply. Although some highly productive bank-filtered wells are situated below this area (about 30 km downstream of the Ruzin Reservoir dam), most of the water supply for the lower Hornad settlements (which contain about half of the total inhabitants of the basin) comes from outside the basin. The government has adjusted to the long-standing pollution by developing a drinking water supply infrastructure that moves water over long distances. This approach is costly and has left the area with the highest costs for water services in the country.

The poor performance of municipal wastewater treatment adds to the problems of industrial and mine pollution. All municipal plants in the basin are overloaded, and plant expansions and replacements are being constructed piecemeal at a slow pace. Part of the problem has been that realistic water tariffs have not been applied in the past; only in January 1993 were rates raised substantially, and those were still well below the levels needed to achieve full cost recovery. Furthermore, operating costs of water supply and sewerage services in eastern Slovakia are rising more quickly than inflation, and the capital costs of new facilities appear to be quite expensive even compared with U.S. unit costs. In addition, much of the industrial loading on municipal waste treatment plants in the basin comes from agro-processing companies that are surviving (until now) the country's economic restructuring. As a result, there has not been much reduction in industrial emissions to municipal waste treatment plants, though such reduction is common in surrounding countries.

Identification of Priority Projects

On the basis of the assessment of current wastewater pollution problems in the Hornad basin, the WASH team identified nine potential projects (see Figure 1). These projects were classified in terms of size and severity of impact, availability of technical solutions, and financial feasibility. In consultation with government officials, further prefeasibility work was targeted to one project that would combine projects 3, 4, and 7 from Figure 1. The project proposed addresses the cleanup of wastewater problems in the Krompachy area.

Figure 1

Potential Investment Projects

Project No. 1:	VSZ steel complex (Kosice) wastewater treatment plant upgrading for phenols and oil sludges.
Project No. 2:	Rudnany mine sludge lagoon remediation.
Project No. 3:	Krompachy copper smelter air and water emissions controls.
Project No. 4:	Krompachy municipal landfill relocation and industrial sludge lagoon remediation.
Project No. 5:	mercury deposits (Ruzin Resevoir) remediation.
Project No. 6:	Presov municipal wastewater treatment plant (WWTP) replacement.
Project No. 7:	Krompachy municipal WWTP and trunk sewer completion.
Project No. 8:	Spisska Nova Ves WWTP expansion and rehabilitation.
Project No. 9:	Kosice municipal WWTP expansion and upgrading.

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Proposed Project Rationale

The problem to be addressed by the proposed project is the improvement specifically of water quality in the Hornad River from Krompachy to the Ruzin Reservoir. Both the river and the reservoir are highly contaminated with heavy metals and untreated sanitary sewage, which affect downstream drinking water supplies for about 400,000 people. The water supplies of the city of Kosice, for example, the second largest city in the Slovak Republic, are adversely affected by contamination of the Hornad River and the Ruzin Reservoir. Contamination of the Hornad seriously threatens bank-filtered well supplies downstream from Krompachy as well. Figure 2 shows the prefeasibility study site within the Hornad basin.

The Ruzin Reservoir cannot be used as a source of drinking water because of its highly contaminated state. In addition, it is reported to contain about 5 million m^3 of sediments contaminated with mercury, cadmium, nickel, and copper. As a result, drinking water for Kosice must be imported from as far away as the Starina Reservoir, which is 140 km away.

The most significant sources of water pollution in the proposed project area are as follows:

- Kovohuty copper smelter in Krompachy, which discharges copper particulates, arsenic, and other contaminants into the air and water;
- the SEZ electrical components plant, which discharges metal-bearing wastewater from its galvanizing and electroplating operations;
- the municipal waste dump and lagoon along the Hornad River, which contain uncontrolled waste from industries, Krompachy, and six villages;
- the discharge of untreated municipal wastewater from residences and institutions throughout the city into ditches and the river; and
- ore processing facilities and a tailings pond at Slovinky.

The East Slovakian Water Works Authority (VVAK) plans to complete the construction of the new municipal wastewater treatment plant (WWTP) and the new main trunk sewer for Krompachy. In addition, reconstruction and extension of the Krompachy sewerage network has been proposed, as have extension of sewer service to Slovinky and Kolinovce. However, financing for this work is extremely limited.

Project Components

The proposed project provides a comprehensive effort to address the critical industrial and municipal wastewater pollution problems within the Krompachy area. The proposed project is broken into three phases based on priority ranking. These rankings are based on the severity of the problem being corrected, the availability of technical solutions to the problem, and the availability of funding to undertake the work. Given the scarcity of financial resources for all types of infrastructure and environmental investments now in Slovakia, it is likely that the project components will be implemented separately.

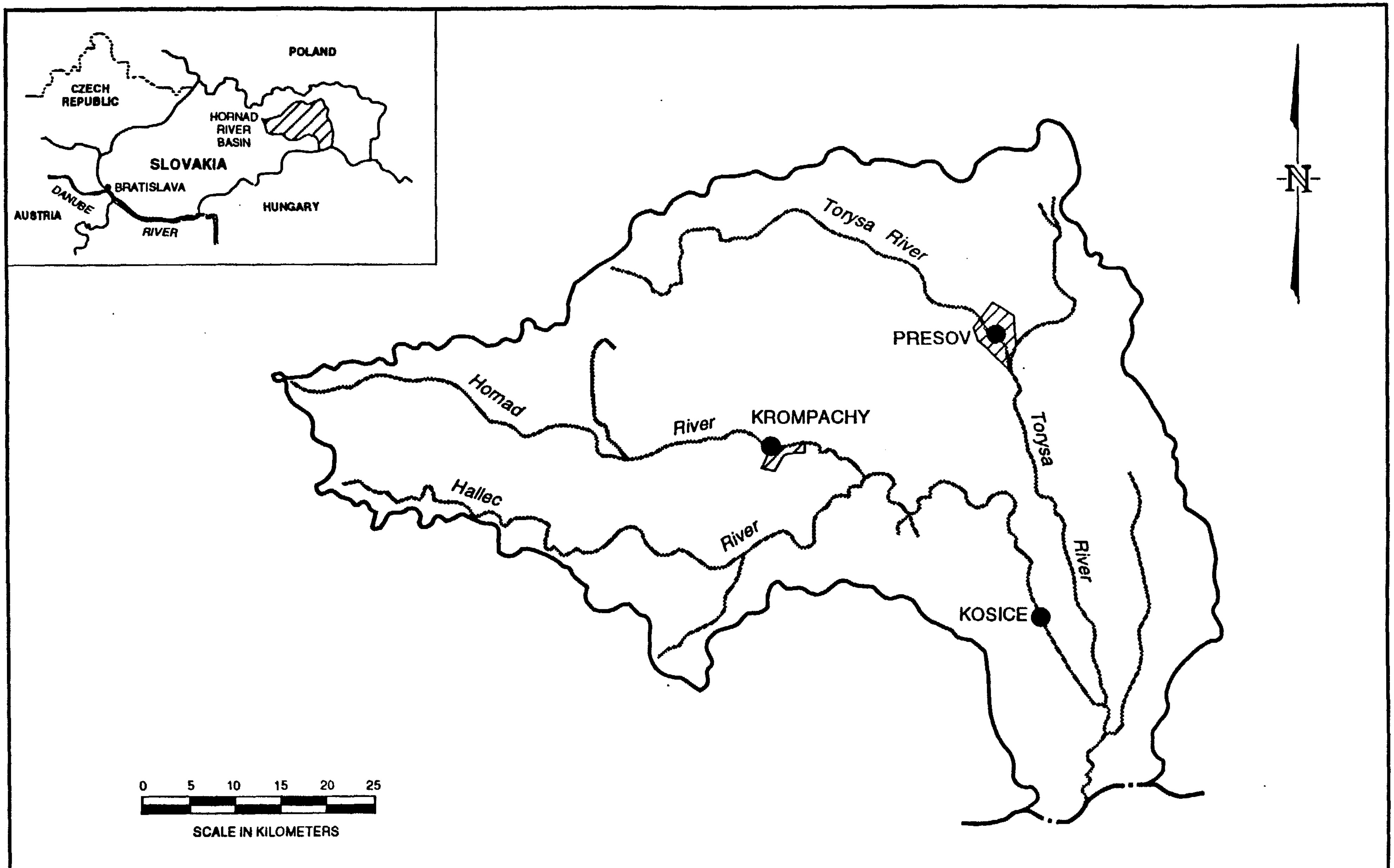

Figure 2
Map of the Hornad Basin Study Area

Phase 1: Highest Priority

The following component addresses the biggest single pollution problem within the target area, namely the emission of large amounts of heavy metals (mainly arsenic, copper, and zinc) through air exhausts of the Kovohuty copper smelter. These air emissions are very significant and may be responsible for high contaminant levels measured in downstream waters. They dwarf the impact of all industrial and municipal wastewater discharges.

The smelter is currently considering a package of investments and process changes, including the following: using alternative technologies in the copper smelting process that would both improve production efficiency and reduce emissions; shifting to higher-grade ores; and installing emission control devices to meet environmental standards.

Component 1.1: Institute air emissions control for the Kovohuty copper smelter.

Component 1.2: Complete the SEZ industrial wastewater treatment facility improvements.

Phase 2: High Priority

The following activities should be undertaken as soon as financing arrangements can be secured. Some of the technical assistance activities (redesign of the Krompachy municipal WWTP and main trunk sewer now under construction, the plan for improving the solid-waste dump site, and assistance in agency operating efficiency) should be considered high-priority candidates for donor grant funds now being programmed. Special attention has been given to the capacity and design standards of the municipal wastewater treatment plant and trunk sewer. The WASH team recommends complete redesign of both facilities in order to reduce the plant capacity by half (in line with realistic demand projections) and replace the currently proposed trunk sewer tunnel with a lower-cost alternative. Given the current state of their construction, merely modifying the systems to lower their operating costs would not make them more affordable.

Component 2.1: Relocate the municipal solid-waste landfill.

Component 2.2: Design and construct sewer extensions in Krompachy (including hospital and industrial sanitary wastewater connections).

Component 2.3: Complete the redesign of the Krompachy municipal wastewater treatment plant and trunk sewer.

Component 2.4: Improve wastewater sludge disposal from SEZ and the Kovohuty smelter industries.

Component 2.5: Improve the operating efficiencies of the water supply and wastewater agencies.

Phase 3: Lower Priority

Component 3.1: Monitoring groundwater impacts of mine tailings lagoon at Slovinky.

Implementing the Project

The project components are divided between industrial sites and municipal sites. The highest-priority component, reducing heavy metals in Kovohuty air emissions, will depend largely on introduction of new technology to the production processes, as well as switching to higher-grade ore. This new investment, in turn, depends on the long-term commercial viability of the copper smelter, which may likely involve participation of outside joint venture partners. One of the issues that must be dealt with before any such joint ventures occur is the limitation of liability for hazardous waste cleanup. At present, the extent of hazardous waste accumulation in the area that is traceable to the copper smelter is unclear, as is the extent of legal liability for cleanup that will be assigned to the smelter after privatization.

The municipal government currently has a mandate to manage the solid-waste facilities, and it may acquire additional responsibilities under proposed reform of the water supply and sewerage sector. Since the shape of reform in the sector is not yet clear, implementation responsibility for the municipal WWTP and sewerage network will remain with the regional water works authorities. Furthermore, tax reform for the municipalities has not yet been completed; therefore, the municipal governments are operating with greatly reduced revenues. It will remain uncertain whether they will have adequate resources to finance infrastructure investments until after the municipal tax reforms are put in place in late 1994.

Financing the Program

Figure 3 presents the cost estimates for each of the proposed project's components.

Industrial sites: Preliminary discussions with the management of the Kovohuty smelter indicate that the enterprise is profitable and that the level of investment needed to correct its air emissions problem should be within the means of the company. Furthermore, the company will be paying an increasing amount of fines each year as long as its air emissions exceed prescribed limits. However, the company is awaiting the outcome of Slovakia's privatization process before undertaking the investment in new technology, which would be the most cost-effective way to reduce its emissions. The new wastewater treatment facility at the SEZ industrial site has funds earmarked for its completion; the SEZ management foresees no problem in completing the facility.

Municipal sites: The relocation of the municipal solid-waste dump will require a modest investment by the municipal government. However, the municipality has no investment funds at present and would require either a grant or loan to undertake the project. Currently, the

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only source of such funding would be a grant from the Environmental Protection Fund,[1] barring some sort of special appropriation from the state budget.

Preliminary discussions are also under way to establish some form of municipal lending program, but that would take several years to establish and capitalize. In the meantime, the central government may want to consider establishing a "transitional" infrastructure financing scheme that can at least keep some funds flowing to high-priority projects.

Figure 3

Project Components and Their Cost

Phase 1	$US
Institute air emissions control for Kovohuty copper smelter	7,000,000
Complete the SEZ industrial wastewater treatment plant	No cost
Phase 2	
Relocate the municipal landfill	790,000
Design and reconstruct sewers in Krompachy	2,330,000
Redesign the Krompachy municipal sewerage and wastewater treatment plant and trunk sewer	4,260,000
Improve wastewater sludge disposal from SEZ and the Kovohuty smelter	Unavailable
Improve the operating efficiencies of the water supply and wastewater agencies	200,000
Phase 3	
Monitor the groundwater impacts of the mine tailings lagoon at Slovinky	No cost

[1] Under current legislation, the Environmental Protection Fund can only make grants, although proposals are now under consideration to enable it to make loans as well.

The financing of the Krompachy municipal WWTP and main trunk sewer raises a set of special problems. First, the cost of the project is quite high in terms of cost per household served. Even with the lower-cost redesign proposed by the WASH team, the cost to complete only the WWTP and trunk sewer totals more than $US 2,100 per household. This is in addition to the amount already invested in construction (about $US 1,300 per household) and the amount required to reconstruct portions of the Krompachy sewerage network in need of rehabilitation (about $US 950 per household). In assessing affordability, we may compare this to an estimated annual average income per household in Krompachy of about $US 3,950. Amortizing the total cost of these investments over 15 years at the current (controlled) interest rate of 16 percent would require an amount equal to about $US 780 per year per household, or almost 20 percent of total household income.

The East Slovakian Water Works Authority (VVAK) has budgeted a small amount to keep a construction of the Krompachy project going, but that amount is less than the amount needed to match inflation on the remainder of the investment. VVAK itself might be expected to provide some funds toward capital investment with the increased revenue generated by recent large tariff increases. However, VVAK is projecting very large increases in its own operating expenses (up about 100 percent over the past two years) so that it predicts continued operating losses, requiring further state subsidies.

In summary, the mechanisms for generating cost recovery for major water and sewer investments are quite limited at present in eastern Slovakia. Municipal general revenues are insufficient and will not increase until some time after local tax reform takes effect.

The other potential source for cost recovery is via the water/sewer tariff. The tariff does have room for further increase[2], but the operating expenses of VVAK must be much better controlled. Component 2.5 of the proposed project is recommended to help VVAK improve its operating efficiencies.

Key Institutional and Policy Issues

Industrial sites: Two critical issues must be resolved on the industrial side, both of which require action at the national policy level: 1) determination of legal liability for cleanup of past contamination for industries undergoing privatization; and 2) availability of medium-term credit for moderately-sized environmental investments ($US 1 million to 15 million) that are too small to qualify for funding by major international lenders as a single loan project. Until these two issues are resolved, investments in industrial sites will continue to move slowly.

Municipal sites: Three main institutional issues require immediate attention: 1) resolution of the proposals for restructuring the delivery of water supply and sewerage services at the local level so that the appropriate financing and management support systems can be put in place; 2) introduction of measures to control both operating costs and capital costs of new facilities

[2] As the residential tariff is raised, consideration can be given to some form of progressive rate structure so that a minimum amount of water per month can be provided to each household at a relatively low price.

of the water works authorities; and 3) creation of a capital financing structure that can channel both grants and loans to worthwhile projects at the local level. Resolution of the first issue will largely determine how the other two will best be handled.

Chapter 1

EXISTING CONDITIONS

1.1 General Features of the Basin

The Hornad basin is located in eastern Slovakia and includes all of the administrative districts of Kosice, Presov, and Spisska Nova Ves (plus very small fractions of Poprad District to the west and Bardejov District to the northeast). The basin lies entirely within the region of the Hornad-Bodrog River Basin Authority (see Figure 4).

The Hornad River system is composed of two major subbasins (the main Hornad stem and the Torysa River), and one minor subbasin (the Hnilec River). Each of the subbasins contains important tributary systems (see Figure 5).

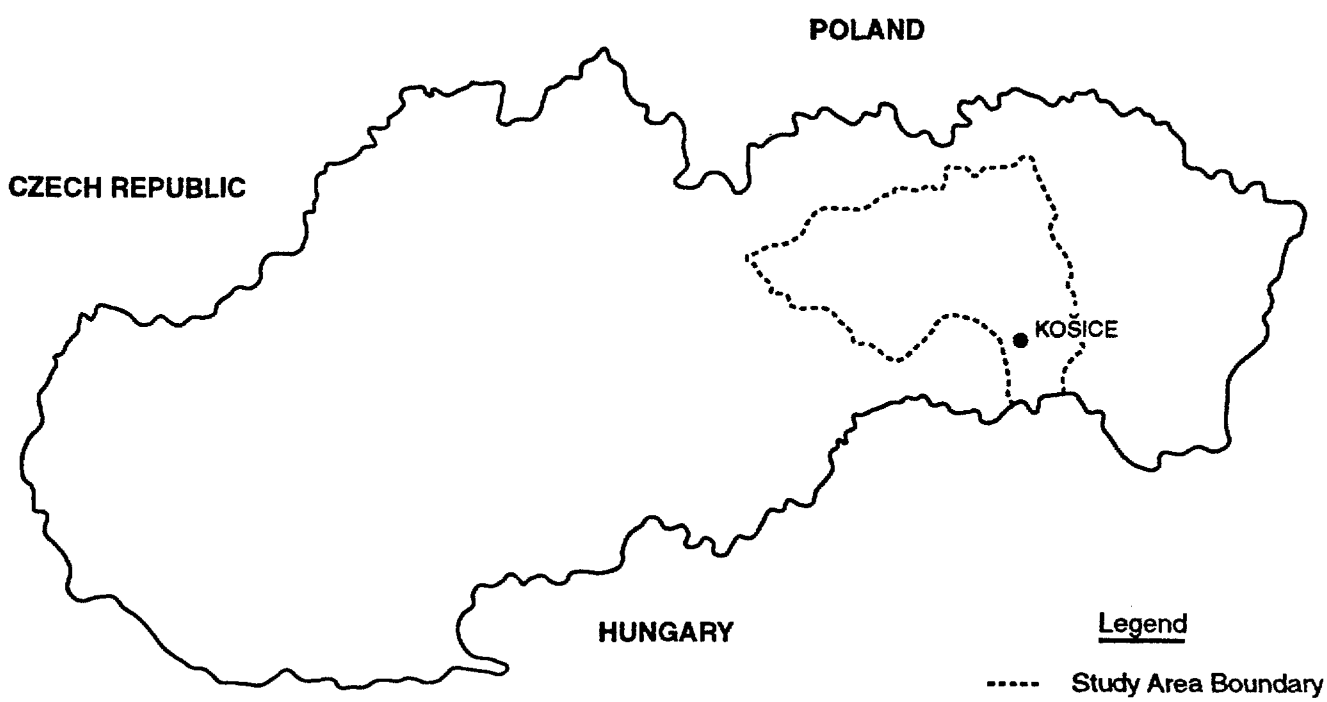

Figure 4

Map of the Hornad Basin in Slovakia

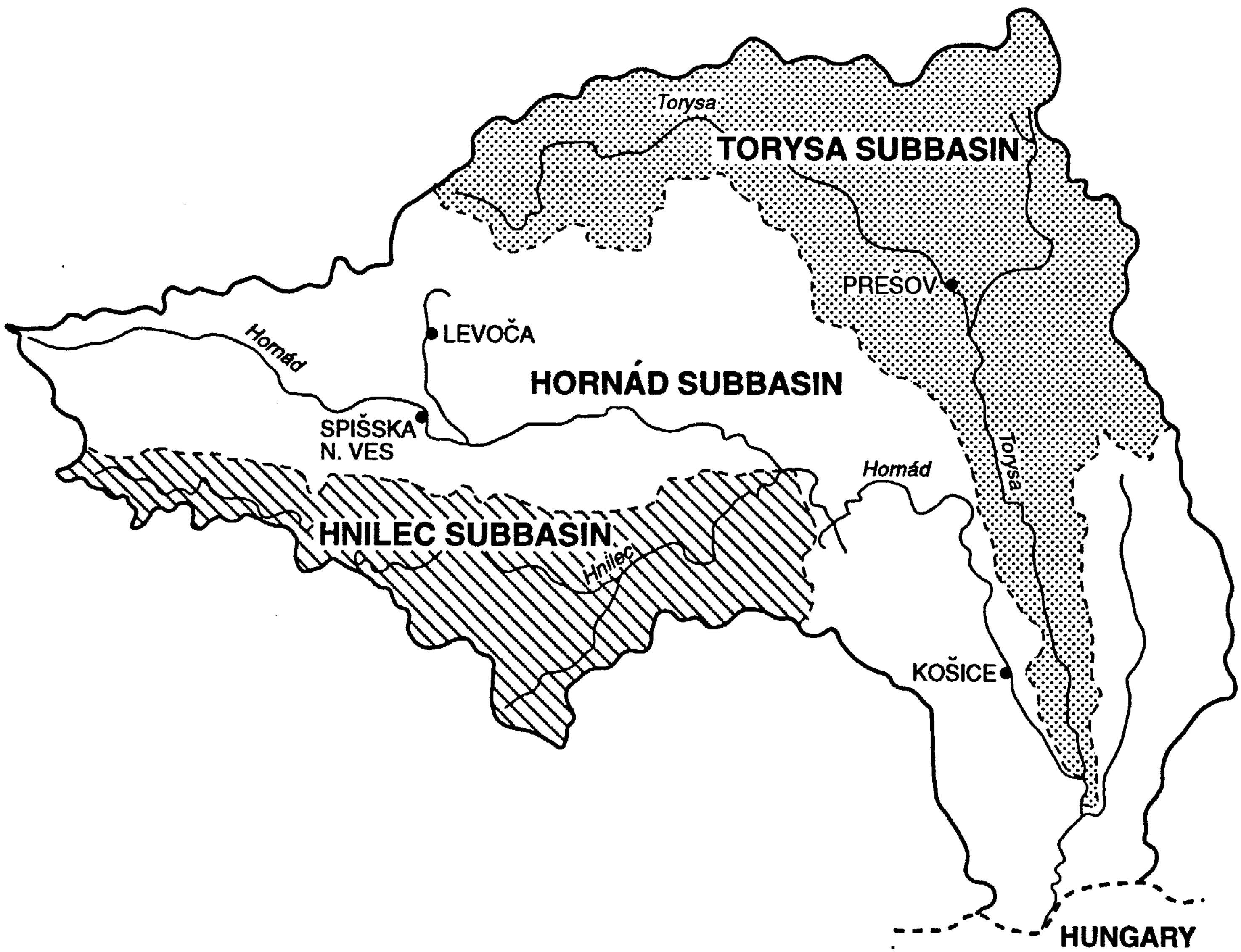

Figure 5

Map of Major Subbasins

The Hornad system originates entirely in Slovakia and drains a total area of 4,346 km^2 within the country (Table 1). The Hornad River flows into Hungary (named the Hernad in Hungarian), where it drains an additional 1,013 km^2 before joining the Sajo River (Slana in Slovakian) south of Miskolc. The other main tributary to the Sajo is the Bodva, which also originates in southern Slovakia; the Bodva basin lies immediately west and south of the Hornad (and serves as an important drinking water supply source for Kosice).

Table 1

Hornad Basin Drainage Area

Catchment	Drainage Area (km^2)
Hornad (main stem)	2,342
Torysa River	1,349
Hnilec River	655

Total basin	4,346

The Hornad basin is quite mountainous and has numerous closed valleys. It is bordered on the east by the Slanske range, which separates the Hornad from the Bodrog River basin. To the north are the Cergo and Levoca mountains. The western border consists of the Low Tatras, and to the south lie the Volonske Mountains. The Volonske range is principally granite gneiss; the Low Tatras, a mixture of sandstone, shale, and limestone. The northern mountains are composed mainly of sandstone; the eastern mountains are of volcanic origin.

1.1.1 Climate

The annual rainfall varies from about 580 mm in the lower part of the basin to about 850 mm in the upper parts. The temperature varies dramatically from the river valley floor to the mountains. In Kosice, the temperature ranges from about -3.6°C in January to 19.6°C in July. In Spisska Nova Ves, it ranges from -5.8°C to 17.3°C.

1.1.2 Land Use and Settlement Patterns

The Volonske range separates the basin into two main settlement areas: the Kosice-Presov corridor, which stretches from the Hungarian border below Kosice through the Torysa valley above Presov; and the Spis region in the western end of the Hornad basin. At the midpoint of the basin (around Krompachy) are the major mining and ore processing industries (see Figure 6).

The total population of the basin was 656,600 in 1991, with 60 percent of the total concentrated in the six largest cities.

Kosice is the principal urban center of the basin, in the heart of the basin's largest agricultural area. The plains stretching south and west of Kosice support sugar beets, corn, wheat, and pasturage for dairy and meat industry animals. Kosice is the area's main industrial and agricultural processing center as well as serving as its administrative and educational center (see Table 2 for a breakdown of area settlements).

Table 2

Population of Settlements with More Than 5,000 Inhabitants, 1991

Municipality	Population
Kosice	234,840
Presov	87,789
Spisska Nova Ves	39,187
Levoca	12,681
Sabinov	10,655
Krompachy	8,241
Gelnica	6,278
Lipany	5,514

The largest industry in Kosice is the East Slovakian Iron Works (VSZ), which is the largest steel complex in the country and the largest single employer in the eastern part of Slovakia. The country's food industry is concentrated in Kosice and includes canning, meat packing, dairy, and brewery industries. The main technical university in eastern Slovakia is located at Kosice, which is also the site of the principal commercial airport for eastern Slovakia.

Kosice is linked to Presov (about 35 km north) by rail and highway, as well as by the Torysa River. Presov is also a productive agricultural region extending along the upper Torysa. The area operates poultry, meat packing, and canning industries, as well as a large brewery and several garment industries. The Spis region is also agricultural, specializing in potato crops, meat, and dairy products. Its main industries are primarily agri-based, with a growing amount of tourism. The Spis region has several important tourist assets, including its proximity to the High and Low Tatras recreation areas, the location of the Slovensky Raj nature preserve on its western border, and the attractive historical architecture of several Spis towns, notably Levoca and Spisska Nova Ves.

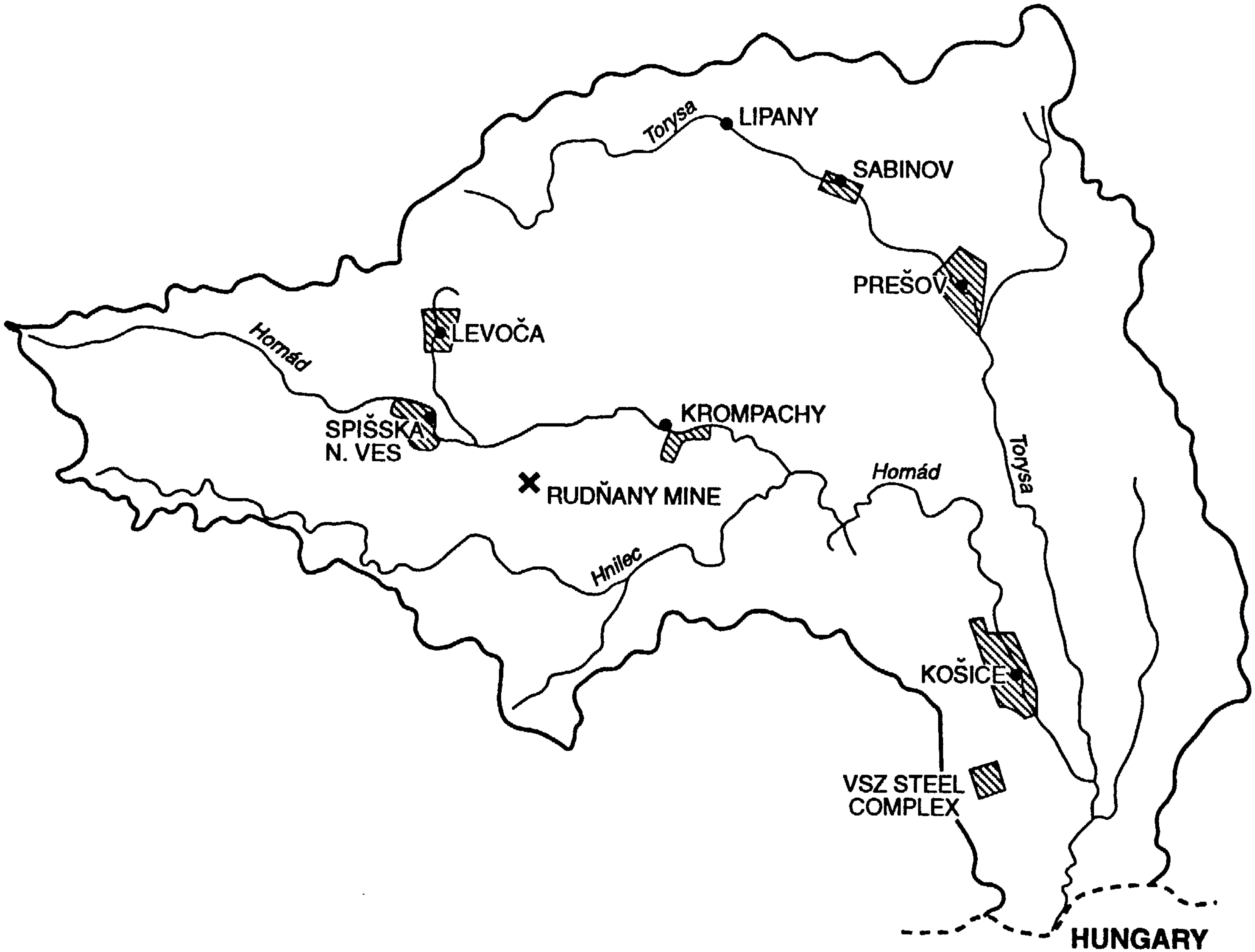

Figure 6

Settlement Patterns

The central region around Krompachy is dominated by mining, ore processing, and copper smelting. The main metal ores are copper, iron, and mercury. The ores are fairly complex and not particularly rich so that a considerable amount of processing is required, producing a high volume of waste. The area has been mined for more than 400 years with a significant amount of hazardous waste ore (especially mercury) finding its way into the Hornad River during that time. Two main ore mines are located in Slovinky and Rudnany. The former will probably shut down soon but the latter will continue operations.

Unemployment is quite high throughout the region as the industrial, mining, and agriculture sectors undergo restructuring. Most of the major industries and agricultural cooperatives have remained under state control; however, subsidies have been cut and the work force reduced in almost every enterprise. Kosice is experiencing growth in its service and retailing establishments, which is taking up some of the slack from the major industry layoffs. The town is somewhat buffered by its wide employment base and the presence of a major university and governmental offices. The Spis region will likely become more dependent on tourism, given its comparative advantage in that regard and lack of alternatives. This also means that environmental protection will become increasingly more important if the region is to remain attractive. The central region around Krompachy has the fewest economic choices given its narrow industrial and mining base.

1.2 Water Resources

The Hornad basin is rich in water resources but, because of contamination problems in the main settled areas, much of its drinking water supply must be brought in from outside the basin. Table 3 shows the breakdown of water supply sources in the basin for the area's three main districts (Kosice, Presov, and Spisska Nova Ves). The table makes several important points:

- Kosice makes no use of surface water supply within the basin and gets two-thirds of its total water supply from outside the basin.
- Only the Spisska Nova Ves district gets a sizable fraction of its water supply from surface waters.
- Of all drinking water in the basin, 40 percent comes from outside the basin.

Table 3

Water Supply Sources, Hornad Basin, 1991

District	Liters per Second: Within Basin Surface	Within Basin Wells	Outside Basin	Total
1. Kosice	0	502		
from Bodva			535	
from Bodrog			535	
Kosice total				1,572
2. Presov	142	639		781
3. Spisska N. Ves	212	196		
from Vah			80	
Spisska N. Ves total				488
Totals	354	1,337	1,150	2,841
Percent of total	12.4	47.1	40.5	100
Percent of within-district total	20.8	79.2	-	-

Table 4 shows the main locations of water sources in the basin, keyed to the map shown in Figure 7. Within the basin, the most productive areas are as follows:

- the upper Torysa, which accounts for about 675 L/sec (40 percent of total within-basin production);
- Hornad bank-filtered wells just north of Kosice, which provide about 250 L/sec (15 percent of basin production); and
- the upper Hornad above Spisska Nova Ves, which provides about 200 L/sec (12 percent of current total basin production).

Table 4

Breakdown of Key Water Sources, Hornad Basin, 1991

District	Sources	Amount (L/sec)	District Supply (%)
Kosice	Sokol/Teplicany		
	Hornad area (wells)	250	15.8
	Kosice area (wells)	204	13.0
	other area (wells)	48	3.0
	imported (Bodva, Bodrog)	1,070	68.0
Presov	Upper Torysa		
	various wells	535	68.5
	Tichy Creek (surface)	140	17.9
	Presov area (wells)	68	8.7
	other area	38	4.9
Spisska Nova Ves	Upper Hornad		
	Bystra Creek (surface)	128	26.2
	Smizany (wells)	76	15.6
	Levoca (wells)	54	11.0
	Hnilec tributaries (surface)	50	10.2
	other area	100	20.5
	Imported (upper Vah)	80	16.4

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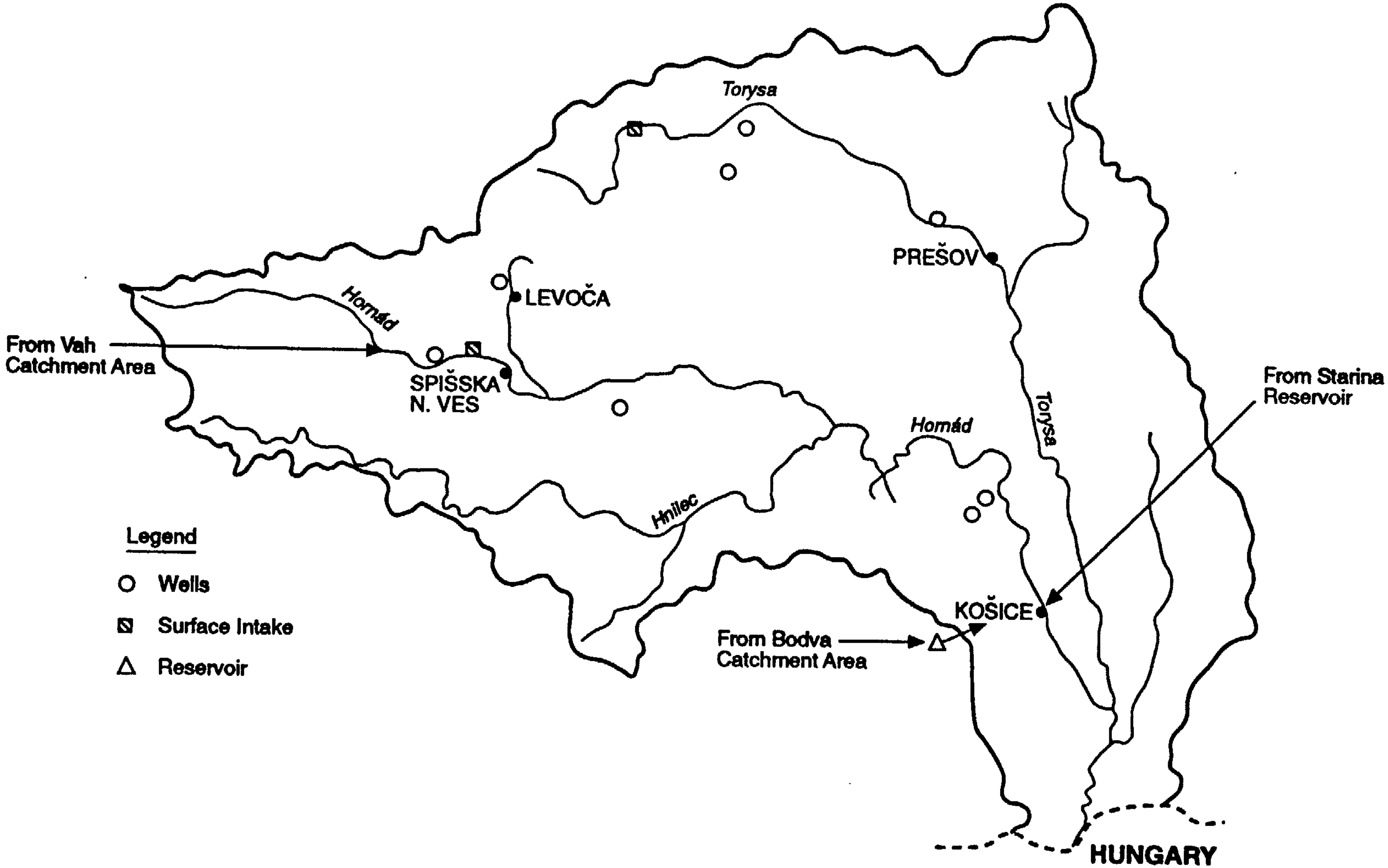

Figure 7

Location of Most Important Drinking Water Sources in Hornad Basin

Kosice imports water from two sources outside the basin: the Bodva valley just west of Kosice, which accounts for about 535 L/sec that is stored in a water reservoir at Bukovec just west of the city; and the Starina Reservoir in the extreme northeast of Slovakia (140 km from Kosice), which also accounts for 535 L/sec.

The upper Torysa is targeted for expansion as a main supply source in the basin with construction of a reservoir at Tichy-Potok Creek (currently a surface water intake for Presov). The upper Hornad above Spisska Nova Ves in the Slovensky Raj is also a highly productive area; however, its designation as a national park complicates the development of water resources within its borders.

The area below Kosice is rich in groundwater (from an aquifer fed by the Hornad and Torysa), but it is not used for municipal water supply because of high levels of nitrates (from agriculture and sewage contamination), as well as high levels of naturally occurring chloride. Currently this area is only used for well water supply for the VSZ plant.

The area below Presov along the Torysa is also rich in groundwater resources, but high levels of nitrates as well as naturally occurring iron and manganese make it unsuitable for drinking water. Many of the previously used bank-filtered wells have now been shut down.

1.2.1 Reservoirs

One major reservoir, the Ruzin, sits on the Hornad below Krompachy; it is used for flow control, recreation, industrial water supply to Kosice, and hydropower. It also serves (fortuitously) to catch the heavy-metal sediments flowing from the mining operations upstream, protecting somewhat the water quality in the lower reaches of the Hornad. A reservoir on the upper Hnilec is used for hydropower generation and drinking water supply to Dobsina in the Slana River basin. The other major reservoir is the drinking water reservoir for Kosice in the upper Bodva, described above.

1.2.2 Stream Classification System

The present Slovakian system of stream classification was established by law on July 1, 1990 (CSN 75 7221). It increased the number of water-quality parameter groups from three to five and retained five stream-quality classifications. This system classifies streams according to existing water quality but does not reflect desired water uses. Stream classifications range from I (best) to V (worst) based on parameter assessment.

Classifications are made in the Hornad basin by the Bodrog-Hornad River Basin Authority (PBaH) for four groups of parameters. The parameters included in each group can be identified in Table 5. In general, the four parameter groups may be distinguished as follows:

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Table 5

Quality of Surface Water in the Hornad River Basin
According to CSN 75 7221, 1990-1991

Sampling Point No.	River	Location	River km	A		B		C		D	
				Parameters							
1	Ganovsky Cr.	Mouth	0.7	II	A3 A4	IV	B6 B7	IV	B2	III	32 38 13
2	Hornad	Betlanovce	149.5	II	A3 A4	V	B7 G2	II	B2 B4 B5	III	38 13
3	Hornad	Smizany	126.4	II	A3 A4	IV	B7 G2	II	B2 B4 B5	III	13
4	Hornad	Spisska Nova Ves →	124.6	V	A5	V	B7 G2	III	75	V	38 13
5	Rudniansky Cr.	Mouth	0.4	II	A3	V	C5	V	B2	IV	38 13
6	Hornad	Kolinovce	100.7	III		V	B7 G2	II	B1 B2 C7	IV	38 13
7	Slovinsky Cr.	Mouth	0.1	IV		V	C5	IV	C6	V	38 13
8	Hornad	Krompachy →	95.0	III	A3	V	B7 C5 G2	IV	C6	V	38
9	Hnilec	→ P. Masa dam	75.4	II	A3	IV	C5	I	B1,2 B4,5	III	38 13
10	Hnilec	P. Masa dam →	71.4	II	A3	IV	C3,5 G2,25	I	B1,2 B4,5	III	38 13

Table 5 (continued)

Sampling Point No.	River	Location	River km	Parameters: A		B		C		D	
11	Smolnik	Mouth	0.4	II	A3 A4	V	C3 C4 C5	III		V	32
12	Hnilec	Mnisek →	22.2	II	A3 A4	V	B7 C4	III	45	III	32 13
13	Hnilec	→ Ruzin Reservoir	4.1	II	A3	V	G2	II	B2 C7	V	38
14	Hornad	Mala Lodina	64.8	II	A1 A3	III	G1	II	B2 75	III	13
15	Svinka	Obisovce	2.0	II	A3	V	B7	II	75	IV	13
16	Hornad	Trebejov	48.2	III	A3	IV	B7	III	75	III	13
17	Hornad	Tahanovce	38.8	V	30	V	C5 G2	II	B2 C7 75	III	38 13
18	Hornad	Krasna n/H	27.0	III	A3	V	B7	II	B1 B2 B5	IV	13
19	Torysa	N. Repase →	119.9	III	A3	IV	C3	I	B1 B6	III	38 13
20	Olsavica	Mouth	0.1	II	A3	IV	C3 B7	I	B1 B2	III	38 13
21	Torysa	→ Tichy Potok	112.7	II	A3	III	B7 G3	I	B1 B2	III	38 13

Table 5 (continued)

Sampling Point No.	River	Location	River km	Parameters A		Parameters B		Parameters C		Parameters D	
22	Torysa	Brezovica	105.7	II	A3	IV	C3	I	B1 B2	III	38 13
23	Torysa	S. Michalany	73.3	IV	30	IV	B7	II	B1 B2 C7	V	38
24	Sekcov	Raslavice →	29.5	II	A3 A4	IV	B7	II	B1 B2	V	38
25	Sekcov	Mouth	0.2	V	30	V	B6 B7	V	B1	V	38
26	Torysa	Haniska	53.8	V	A1 30	V	B7 C5	IV	75	V	32 38 13
27	Torysa	Kosicke Olsany	13.0	IV	A1	IV	B7 G1	III	75	V	38
28	Olsava	Mouth	0.6	III	A3	IV	B7	I	B1 B2	III	32 38 13
29	Hornad	Zdana	17.2	IV	A1 30	V	B7 C5 G2	IV	C6	V	38 13
30	Sokoliansky Cr.	Hungary	0.0	V	30	V	B7, C4 C5, G2	IV	C6		

Table 5 (continued)

Sampling Point No.	River	Location	River km	Parameters A		Parameters B		Parameters C		Parameters D	
31	Hornad	Hungary	0.0	IV	A1 30	V	B7 C2	IV	C6	V	13

Legend

III Class (group) of water quality
38 Codes of parameters resulting in certain classification
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Code	Parameter
A1	dissolved O_2
A3	BOD_5 (biochemical oxygen demand from 5-day test)
A4	COD_{Mn} (chemical oxygen demand)
A5	sulphites
30	COD_{Cr}
B6	dissolved solids
B7	suspended solids
G2	$N - NO_2^-$
C4	Fe total
C5	Mn total
C3	pH
25	P
G1	$N - NH_4^+$
B2	SO_4^-
B4	Ca
B5	Mg
75	oil products (nonpolar. extr. subst.)
B1	Cl^-
C7	detergents (anionic)
C6	volatile phenols
45	F^-
32	
38	Psychrofilic bacteria
13	coliform bacteria

Notes

(1) Classifications by river basin authority (PBaH).
(2) Stream classifications and sampling points are illustrated in Exhibit 10.

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- Group A - oxygen regime indicators;
- Group B - basic chemical indicators;
- Group C - secondary chemical indicators; and
- Group E - bacterial and biological indicators.

The roman numerals in the "parameters" column in Table 5 represent stream classification ratings. Codes such as A1, B7, and C2 refer to specific parameters, which, for simplicity's sake, are described in the legend to the table (for example, in the legend one finds that A1 stands for dissolved oxygen).

Water quality in the Hornad basin is discussed in the following section.

1.3 Existing Water Quality

1.3.1 Surface Water Quality in the Hornad Basin

Surface water quality in the Hornad basin has been determined since 1985 by means of monthly samples taken by the PBaH at 31 sampling points (see Figure 8). At each sampling point, 24 parameters are measured to establish the stream classification (Table 5). Also since 1985, the content of heavy metals in surface water and sediments has been monitored at 7 sampling points.

Based on inspection of water-quality profile data in the Hornad, the Hnilec, and the Torysa rivers, water quality underwent no significant change from 1985 to 1990. Current conditions of surface waters in the basin are discussed below.

Starting at the upstream end of the Hornad River to Spisska Nova Ves, the water is polluted from agricultural and recreational activities. In the spring, pollutants exceed the stream's self-cleaning capacity, and its low water quality prohibits the stream's use for drinking even after treatment.

From Spisska Nova Ves downstream to the Ruzin Reservoir, the Hornad River is badly polluted from industrial, municipal, and other pollution sources. River water quality is Class V in this reach. Heavy metals and inorganic substances are evident, especially mercury, copper, zinc, chromium, and manganese. Mercury salts cause a serious problem in both the water and bottom sediments. The tributaries—Rudniansky, Ganovsky, Levocsky, and Slovinky creeks—are also seriously polluted in this area. Water quality in both the Hnilec and Hornad rivers entering Ruzin Reservoir is Class V.

Water quality in the Ruzin Reservoir significantly improves during its residence there, such that it reaches Class III levels downstream from the dam, as shown in Figure 8. Pollution levels then proceed to build up again in the Hornad main stem, finally degrading the river back to

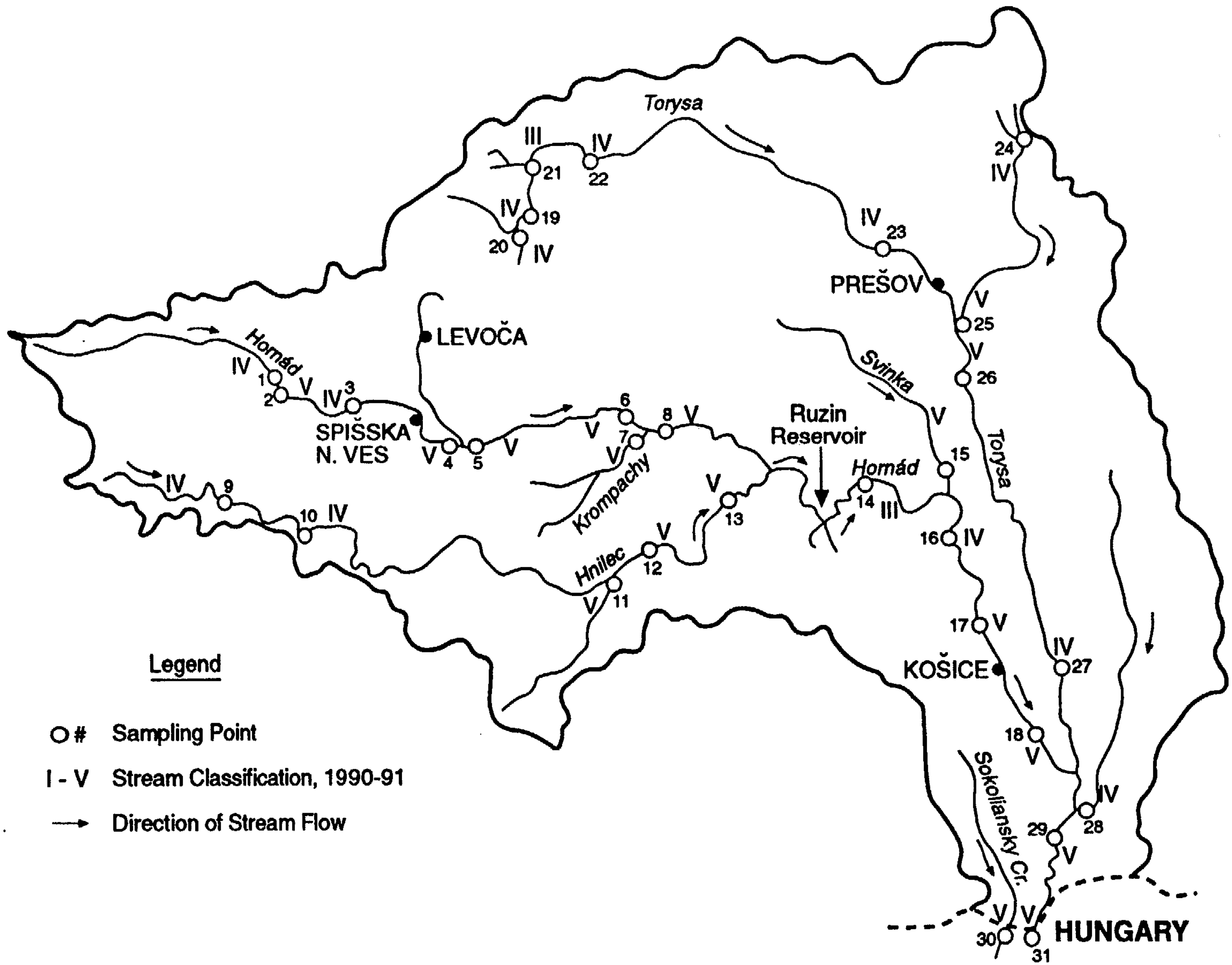

Figure 8

Sampling Points and Stream Classifications

Class V at Kosice. Pollution sources in Kosice and insufficient wastewater treatment at the Kosice wastewater treatment plant (WWTP) are primary causes of this degradation. The Hornad River enters Hungary in Class V condition.

Water in upstream reaches of the Torysa River is used for supplying local inhabitants with drinking water. Its quality varies between Class III and Class IV. Below Lipany and Sabinov, water quality remains Class IV, and below Presov it drops to Class V because of pollution sources in and near Presov and because of insufficient wastewater treatment.

Sokoliansky Creek enters the Hornad River below the Hungarian border. It carries treated wastewater from the metallurgical complex, VSZ. The new VSZ WWTP has been operating since 1991, and it is expected that water quality in the creek will improve to better than Class V.

Several observations may be made from the data with reference to World Health Organization (WHO) water-quality guidelines (see Table 6 and Figure 8):

- Nitrate (NO_3) concentrations exceed the maximum allowable level of 10 mg/L for drinking water at all sampling points except one (point 10, dam at water reservoir).
- Coliform levels greatly exceed the 10/100 ml standard at all sampling points. The highest levels, indicating the greatest danger to public health, are at sampling points 29 (below Kosice), 4 (below Spisska Nova Ves), and 26 (below Presov). This condition appears to reflect the discharge of raw and inadequately treated sewage and animal waste into the rivers.
- The water in the reaches of the Hornad and Hnilec rivers upstream from the Ruzin Reservoir show high concentrations of heavy metals. Water quality leaving the reservoir is little better. Heavy-metal levels are above allowable limits at almost all sampling points. Significant increases in concentrations of chromium, copper, mercury, nickel, lead, and zinc appear below Rudnany and Krompachy.
- Concentrations of total dissolved solids (TDS) in irrigation water must be held at or below certain levels to maintain soil productivity. TDS concentrations in the main river system range from slightly above to below the allowable level for irrigation (450 mg/L). In several of the tributary creeks and streams, TDS concentrations are quite high (in milligrams per liter):

☐ Ganovsky Creek	1,218
☐ Slovinky Creek	600
☐ Smolnik Creek	1,001
☐ Torysa River (upstream)	584
☐ Sekcov River	5,124

Table 6

Maximum Allowable Contaminant Levels of Certain Parameters in the Hornad Basin

	Level[a]		
Parameter	**Drinking Water**	**Irrigation Water**	**Fisheries**
Total coliform	0 to 10/100 ml	---	---
Fecal coliform	0	1,000/100 ml	---
Chemical oxygen demand (COD)	---	---	---
Dissolved oxygen (DO)	[b]	---	---
Nitrate (NO_3)	10 mg/L	5 mg/L	100 mg/L
Ammonia (NH_4)	---	---	---
Total dissolved solids (TDS)	1,000 mg/L	450 mg/L	10,000 mg/L
Sodium (Na)	200 mg/L	---	---
Cadmium (Cd)	0.005 mg/L	0.1 mg/L	---
Chromium (Cr)	0.05 mg/L	0.01 mg/L	---
Copper (Cu)	1.0 mg/L	0.2 mg/L	---
Iron (Fe)	0.3 mg/L	5.0 mg/L	---
Lead (Pb)	0.05 mg/L	5.0 mg/L	---
Manganese (Mn)	0.1 mg/L	0.2 mg/L	---
Mercury (Hg)	0.001 mg/L	---	---
Nickel (Ni)	---	0.2 mg/L	---
Zinc (Zn)	5.0 mg/L	2.0 mg/L	---

Notes
(a) WHO water-quality guidelines, 1988.
(b) Must be present but WHO guidelines do not indicate a set number.

- ☐ Torysa River (downstream) 697
- ☐ Sokoliansky Creek 1,653

At four of these locations, TDS concentrations are above the WHO guideline level for drinking water (1,000 mg/L).

The use of river water or bank-filtered water for drinking is a risky practice in the Hornad in the absence of adequate treatment and disinfection.

1.3.2 Analysis of Sediments

The PBaH took sediment samples of 14 heavy metals at 7 locations in the Hornad River basin between 1985 and 1990. Samples were collected monthly between April and September. Maximum concentrations for selected heavy metals obtained during this period are shown in Table 7. Comparison is made with ceiling levels established by the U.S. Environmental Protection Agency in its recently promulgated 40 CFR Part 503, Table 1 of Section 503-13, pollutant limits for land application.

Cadmium levels exceed acceptable levels in the Hnilec River (sampling point 13), the Ruzin Reservoir, and the Hornad River above Kosice (sampling point 17). Chromium, lead, and zinc levels are below the limits. Copper levels are elevated at Rudniansky Creek (5) and the Hnilec River (13). Mercury levels are greatly exceeded at all points upstream from the Ruzin Reservoir, but are within limits downstream. Nickel levels are exceeded at Ruzin Reservoir and immediately downstream (14).

Dredging and application of contaminated sediments on crop-growing lands are inadvisable without proper treatment and close monitoring.

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Table 7

Maximum Heavy Metals Concentrations in the Hornad River Basin (1985–1990) in mg/kg

Sampling Point	Stream Location	Ag	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Zn
5	Rudniansky Creek - mouth	11.1	24.7	315.6	4582.0	$>10^4$	8787.0	6400.0	143.2	46.7	2979.0
---	Hornad below Rudniansky Creek	4.03	24.3	207.8	4201.0	$>10^4$	3308.0	3300.0	143.0	92.4	4379.0
8	Hornad below Krompachy	3.6	49.3	134.0	2339.0	$>10^4$	1979.2	2129.0	326.0	126.3	4356.0
13	Hnilec inflow to Ruzin Reservoir	4.53	288.4	126.6	4619.0	$>10^4$	184.0	9200.0	107.5	84.0	5490.0
---	Ruzin Reservoir - barrage	1.34	355.7	290.7	923.0	$>10^4$	8.9	1030.0	473.9	197.7	N.A.
14	Hornad Mala Lodina	5.71	55.9	194.0	829.0	$>10^4$	44.8	3527.0	1207.3	108.8	5143.0
17	Hornad Tahanovce	1.7	1427.0	115.5	412.5	$>10^4$	10.6	1891.0	223.9	17.4	9857.0
Limits for land application of sludge (U.S.)		---	85	3000	4300	---	57	---	420	840	7500

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Chapter 2

EXISTING EMISSIONS AND WASTEWATER TREATMENT

2.1 Municipal Wastewater Systems

Approximately 59 percent of the Hornad River basin's 656,600 inhabitants are connected to a wastewater collection system. The basin has 12 municipal wastewater treatment plants; 6 of the plants are quite small, serving a total of 5,000 inhabitants. The six large systems serve municipalities within the basin that have a combined population of 359,400, or approximately 55 percent of the population of the basin. These six municipalities are Kosice,

Presov, Spisska Nova Ves, Levoca, Sabinov, and Lipany.

Various characteristics of these six WWTPs are shown in Table 8; Table 9 indicates their emissions data.

The percentage of municipal population served by the sewerage systems of these cities ranges from 79 percent in Sabinov to 100 percent in Levoca. In each of the six cities, the percentage of industrial wastewater flow entering the WWTPs ranges from 9 to 53 percent, much of which receives little or no pretreatment.

The East Slovakian Water Works Authority (VVAK) operates all of the municipal WWTPs in the basin and is also responsible for upgrading existing facilities and constructing new ones.

An inventory of municipal WWTPs either currently planned or under construction is shown in Table 10. All six of the larger plants listed in Table 10 have some activity planned or under way. However, completion in all cases is now delayed due to lack of funds. In addition to the six larger plants, three other municipalities (also indicated in Table 10) have WWTPs planned or under construction; these also are delayed. Facilities currently planned or under construction are estimated to bear a total capital cost of approximately $US 83 million (2.3 billion Kcs).[3]

[3] As of January 1, 1993, the Czech and Slovak currencies split. In April 1993, the Slovakian monetary unit was renamed the Slovak crown (Sk). While this report uses the former symbol for crowns, Kcs, all values given are current.

Table 8

Inventory of Existing Municipal Wastewater Treatment Plants in the Hornad River Basin

Plant Name	Other Settlements Served	Est. Population Served 1992	Year Built[a]	Design Capacity m^3/day x 1000	1991 Flow m^3/day x 1000 Ave.	1991 Flow m^3/day x 1000 Max.	Treatment Process	Sludge Management	Operating Agency[b]
Kosice[c]	–	214,600 (91.4%)	1984	60.5[d]	117.8	518.4	Primary	Heated digestion Dewatering Landfill	VVAK
Presov[e]	Yes	85,300 (97.2%)	1968	22.5[f]	39.7	55.3	Activated sludge	Digestion Dewatering Land application	VVAK
Spisska Nova Ves	–	34,000 (86.8%)	1975	19.9	27.6	37.0[g]	Activated sludge	Heated digestion Dewatering Dump	VVAK
Levoca	–	12,700 (100%)		4.9	6.0[h]	–	Activated sludge	Heated digestion	VVAK
Sabinov	–	8,400 (79.0%)		6.5	7.3	–	–	Dewatering Land application	VVAK
Lipany	–	4,400 (79.2%)		1.4	1.4	–	–	–	VVAK
Total		**359,400**							

Notes
(a) Or latest upgrade.
(b) VVAK is the East Slovakian Water Works Authority.
(c) Phase II plant expansion is under construction.
(d) Hydraulic capacity of headworks is 605,000 m^3/day; secondary treatment capacity is shown.
(e) New plant has been under construction since 1978.
(f) Capacity for secondary treatment; remainder of flow is discharged to the Torysa River with primary treatment only or no treatment.
(g) Flows above 37,000 m^3/day rate are discharged into the Hornad without treatment.
(h) Flow during canning season.

Table 9

Municipal Wastewater Treatment Plant Emissions

	Plant Name	Location	Receiving Water	Plant Discharge River km	Avg. Flow m^3/day x 1000	% Industrial flow	Major industry type	Plant effluent concentrations[1] (mg/L)					
								COD c	BOD_5	SS	N[2]	P[3]	PS
1	Kosice	Koksov	Hornad R.	30	117.8	35.7	Steel Food	90	50	60	24.0	2.0	510
2	Presov	Haniska	Torysa R.	56	39.7	25	Cannery	235	75	65	23.2	1.7	600
3	Spisska NovaVes	S.N.V.	Hornad R.	130	27.6	25.5	Starch Food	915	128	174	12.2	3.7	570
4	Levoca	Levoca	Levocsky Ck.	1.50	6.0	9.3	Cannery Distillery	95	52	87	16.6	4.7	485
5	Sabinov	Orkucany	Torysa R.	79	7.3	23.9	Cannery	75	40	35	16.0	1.8	640
6	Lipany	Lipany	Torysa R.		1.4	52.9	Milk products	50	25	30	20.0	1.6	555
	Effluent standards (US) (Typical)							25	15	20	3.0[4] 6.0[5]	1.0	500

<u>Notes</u>

(1) Annual average concentrations for 1990; samples collected and analyzed monthly by the River Basin Authority (PBH).
(2) Total nitrogen.
(3) Phosphorus as PO_4.
(4) Summer.
(5) Winter.

Four municipalities (Krompachy, Gelnica, Smizany, and Spisske Vlachy) operate or have plans for wastewater collection systems but do not have operating wastewater treatment plants. These four municipalities have a total population of about 29,500, and only Krompachy now has a new municipal WWTP under construction.

The sewage from approximately 44 percent of the basin population is discharged without treatment into the Hornad River and its tributaries. Furthermore, the levels of treatment provided by existing overloaded WWTPs are inadequate, as discussed below. The lack of adequate treatment, disinfection, and sludge disposal presents serious public health hazards to downstream water users.

The following section discusses the situation in the six large municipalities that do operate WWTPs and four municipalities where plants are proposed or are under construction. One of these municipalities, Presov, has both an existing WWTP as well as one under construction.

2.1.1 Kosice

The Kosice WWTP now discharges partially treated effluent into the Hornad River about 5 km downstream from the city. It receives flow from a combined sewer system, which contains a number of major upstream combined sewer overflows (CSOs) that discharge raw sewage to nearby watercourses during wet weather.

The WWTP was originally placed in operation in 1964-65 and was designed for treating household and steel mill wastewater. Since expansion, it has now achieved a secondary treatment capacity of 60,500 m^3/day and receives an average of 117,800 m^3/day. Thus, the plant is grossly overloaded, and no effluent disinfection is provided. The plant's primary sedimentation facilities were upgraded in 1984 under phase I of new construction, and the secondary (biological) facilities are currently being upgraded to a capacity of 207,400 m^3/day. The maximum flow to the plant has been 518,400 m^3/day; at the time of the WASH team's visit to the plant in November 1992, the flow was 147,000 m^3/day. Flows are projected to increase in the future. Currently, about 20 L/s (1,728 m^3/day) of phenol-laden wastewaters from East Slovakian Iron Works (VSZ) are discharged to the Kosice WWTP, but this will cease when VSZ builds a new biological treatment plant.

Emissions data show the plant's biochemical oxygen demand (BOD) removal lies between primary and secondary levels, or about 64 percent. Suspended solids (SS) removal is now about 60 percent. When phase II is completed, BOD and SS removals in excess of 90 percent are anticipated. Total nitrogen and phosphorus will be little reduced by this treatment, however, unless process changes are implemented, such as chemical addition or denitrification.

Sludge resulting from sedimentation and activated sludge processes is now anaerobically (heated) digested at Kosice, then dewatered on open drying beds to the point of becoming 20 to 25 percent solids. Afterward, a company takes some of the sludge to use as manure. The rest of the sludge is dumped. Thus, the process does not allow for much beneficial use of the

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sludge as a soil conditioner or fertilizer. Additionally, the sludge digesters are in questionable structural condition, and the use of open drying beds is inappropriate for a plant of this size. Phase III of the planned upgrading is expected to address sludge management.

There appears to be adequate justification for increasing the hydraulic and treatment capacity of the plant, for the following reasons:

- unsewered areas of Kosice will be connected,
- industrial production is expected to increase,
- an allowance is needed for increased future sewage flow rates, and
- capacity for controlling or handling wet weather inflow and infiltration is needed.

Because of the great impact of the Kosice WWTP on water quality in the Hornad, the plant must be upgraded to provide a minimum of secondary treatment with denitrification to all flows received, and improved sludge management facilities and practices are urgently needed. Specific recommendations include the following:

- Sludge treatment and disposal options such as composting, incineration, and N-Viro soil technology should be investigated for cost-effectiveness.
- Industrial waste pretreatment must be closely monitored and controlled to prevent plant upsets and to ensure that sludge meets quality requirements for land application.
- The extent of infiltration and inflow into the system should be estimated (it is known to be high).
- Continuous disinfection of plant effluent being discharged to the Hornad should be considered because of its impact on drinking water supplies downstream.
- The possibility of the need for advanced treatment to reduce nitrogen and phosphorus levels should be considered, to minimize nitrate contamination and eutrophication problems downstream.

It is estimated that the cost to upgrade the Kosice WWTP will be approximately $US 32 million. This estimate covers both the phase II and III facilities (works) but does not include rehabilitation or reconstruction that may be required in the collection system. In addition, costs for an expanded and upgraded trade waste program are not included.

The World Bank considers the upgrading of the Kosice WWTP to be a top priority.

2.1.2 Presov

The existing Presov WWTP discharges untreated, partially (primary) treated, and secondary treated sewage into the Torysa River. It receives sewage from a combined sewer system that overflows upstream at eight locations 10 to 20 times per year during wet weather.

The WWTP is grossly overloaded, and in an attempt to correct this situation, a new WWTP has been under construction since 1978 about 3 km downstream of the existing plant. (It was originally planned to begin operation in 1986 but is reported to be only 70 to 80 percent complete at this time.) The existing plant has the following capacities:

- primary treatment—330 L/s (28,500 m^3/day),
- secondary treatment—260 L/s (22,500 m^3/day), and
- bypassed to Torysa River—150 L/s (13,000 m^3/day).

Present flows average 700 to 800 L/s, which exceeds normal river flow. The design capacity of the new Presov WWTP is 1,060 L/s (91,600 m^3/day). Its treatment process will consist of primary sedimentation, activated sludge, and denitrification. Sludge processing at the new plant will be the same as at the old (open [cold] digestion and heated digestion followed by dewatering via belt filter presses).

The existing plant receives about 30 to 50 L/s of untreated wastewater from the Saris brewery. When the brewery's WWTP goes into operation in 1993, this flow will no longer pass to the Presov WWTP.

The existing plant uses the activated sludge process, but much of its incoming flow receives primary or no treatment whatsoever. Gas is used for digester heating. Dewatered sludge (at about 25 percent solids) is given away to collective farms.

BOD and SS removals now are estimated to be about 64 percent each. Removals in the new WWTP should exceed 90 percent. To reduce nitrogen levels in the effluent, the plant designer is reevaluating the design. The plan reportedly is to use two of the six secondary settling tanks for denitrification.

Almost all the dewatered sludge produced at the existing WWTP (roughly 84 metric tons per month) is used on land, and sludge quality is closely monitored. An analysis of the sludge in November 1992 revealed the following and is compared with "clean sludge" limits contained in the recently promulgated rule of 40 CFR Part 503, Table 3 of Section 503-13:

Contaminant	Analysis (mg/kg)	Limit (mg/kg)
Lead	104	300
Cadmium	7.65	39
Chromium	725	1,200
Mercury	2.59	17
Nickel	161	420
Copper	698	1,500
Zinc	2,181	2,800

If the above analysis is typical, the sludge appears to be suitable for land application.

There appears to be ample justification for completing construction of the new Presov WWTP. However, several factors must be considered:

- review of the design to ensure cost-effectiveness, especially for sludge processing;
- assessment of the structural soundness and mechanical integrity of facilities already installed, to ensure operability;
- evaluation of infiltration and inflow into the collection system and measures to control it; and
- control of sludge quality and use to minimize health risks and maximize benefits.

It is estimated that the cost to complete the construction of the new WWTP will be approximately $US 18 million. This estimate does not cover rehabilitation or reconstruction that may be required in the collection system, nor replacement of potentially inoperable equipment already installed.

The VVAK considers the completion of the Presov WWTP to be a top priority.

2.1.3 Spisska Nova Ves

The existing Spisska Nova Ves WWTP is overloaded, and there are plans (unfunded) to upgrade the plant. Plant capacity equals the average flow rate (230 L/s or 19,900 m^3/day) during part of the year, but during starch (potato) plant operations, the plant is severely overloaded. Plans have been made to increase the plant's capacity to about 42,200 m^3/day. This increase should prevent most, but not all, plant bypasses.

The WWTP was built in 1975 and has since undergone little upgrading. Its treatment process is typical of plants in the region, with primary sedimentation, activated sludge, sludge digestion, and dewatering. Digester gas is used for heating, and effluent disinfection is practiced.

In addition to potato starch operations, industries in Spisska Nova Ves include dairy, food processing, meat processing, and textiles (including dyeing). All provide some degree of wastewater pretreatment before discharging to the WWTP. During the canning season, hydraulic and organic loads are high.

The plant is operating at its maximum efficiency. BOD and SS removals are 44 percent and 42 percent, respectively. Chemical oxygen demand (COD) is extremely high, which reflects the strong influence of inorganic industrial waste. Nitrogen and phosphorus levels are elevated (12.2 and 3.7 mg/L, respectively).

Sludge disposal presents a problem at Spisska Nova Ves. New belt filter presses are currently being tested. When operational, the sludge drying beds will be used to store the sludge, because no farmers are willing to use it; they fear it contains heavy metals, and the agriculture department believes sludge does not help soils. These potential users lack accurate information, as the sludge actually contains very small amounts of heavy metals. They also require education about the benefits of applying sludge to soils and crops.

The Spisska Nova Ves WWTP clearly needs upgrading. Other specific needs include the following:

- an up-to-date facilities plan to evaluate cost-effective options and to review population, flow, and load projections;
- an evaluation of infiltration and inflow into the collection systems and measures to control them;
- a review of sludge processing, utilization, and disposal options, along with an education program on the benefits of sludge use; and
- an evaluation of continuous disinfection of plant effluent, because of its impact on drinking water supplies downstream.

It is estimated that the cost to upgrade the Spisska Nova Ves WWTP is about $US 17 million. This estimate does not reflect the additional needs listed above.

The VVAK district office in Spisska Nova Ves considers this plant to be a top priority.

2.1.4 Levoca

The Levoca WWTP is an activated sludge plant that discharges into Levocsky Creek some 15 km upstream from the creek's confluence with the Hornad River. It receives normal-strength waste except during canning season (which may last up to six months), when the WWTP is grossly overloaded. BOD and SS removals are about 50 percent and 83 percent, respectively. Sludge is used in land application on collective farms, but it is not clear that sludge quality, application rates, and crop requirements are monitored. Advanced waste treatment is needed to reduce nitrogen and phosphorus to acceptable levels.

The Levoca WWTP, although smaller than the one at Spisska Nova Ves, has similar problems. The Levoca plant was built with a capacity of about 60 L/s (4,900 m^3/day) to treat only municipal waste. During the canning season, however, the average flow is 70 L/s (6,000 m^3/day). The cannery has no waste pretreatment before discharge to the WWTP and reportedly must do something by next season or stop production. When the Levoca WWTP is overloaded, the municipality is fined as a polluter.

Even if the cannery should build its own waste treatment facility, plant upgrading is needed for the following reasons:

- a WWTP should have the capacity to treat maximum-period (week or month) flows and not just annual average flows;
- tourist development is expected in the area; and

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- sludge management options and effluent disinfection should be considered as in Spisska Nova Ves.

It is estimated that the cost to provide currently planned sludge dewatering facilities at the Levoca WWTP is about $US 200,000. No estimate of plant upgrading costs has been made.

2.1.5 Sabinov

The Sabinov WWTP is a secondary treatment plant that discharges into the Torysa River. It receives high-strength waste attributed to cannery operations. BOD and SS removals are about 93 percent and 85 percent, respectively. Advanced wastewater treatment will be needed to reduce nitrogen and phosphorus to acceptable levels.

The Sabinov WWTP is also overloaded during the canning season. Comments applicable to Levoca also apply here. The WWTP currently has a capacity of 75 L/s (6,500 m^3/day) compared with an average annual flow of 84 L/s (7,300 m^3/day). Therefore, upgrading with increased capacity is needed.

No estimate of plant upgrading costs has been made.

2.1.6 Lipany

The Lipany WWTP is a secondary treatment plant that discharges into the Torysa River. It also receives high-strength waste attributable to the dairy industry. BOD and SS removals are about 90 percent and 83 percent, respectively. Advanced wastewater treatment will be needed to reduce nitrogen and phosphorus to acceptable levels.

The Lipany WWTP is operating with a design capacity equal to its annual average flow. This means the plant is overloaded frequently during the year. The municipality is planning to upgrade this facility when funds are available.

The estimated cost to upgrade the Lipany WWTP is $US 1.4 million.

The emissions from the above six WWTPs all exceed typical U.S. effluent standards for BOD, SS, nitrogen, and phosphorus. In addition, several plants discharge part of their flow with partial or no treatment. Sludge disposal at most plants should be upgraded.

The following three municipalities' plants are either being planned or are under construction. Specific data for each are shown in Table 10.

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Table 10

Inventory of Municipal Wastewater Treatment Plants in Operation, Under Construction, and Planned

Plant Name	Design Population	Residential Equivalent	Design Capacity m^3/day x 1000	Type of Facilities	Year Work Started	Status	Estimated Cost to Complete US$ x 10^6
1. Kosice							
Phase II	246,300	470,900	207.4	Plant upgrade Sedimentation Activated sludge	1988	Under construction but stopped	15.8
Phase III	246,300	643,300	207.4	Heated digestion Sludge dewatering	—	Planned	16.1
2. Presov	101,900	200,000	91.6	New treatment plant Sedimentation Activated sludge Heated digestion Dewatering	1978	Under construction	17.9
3. Spisska Nova Ves	43,200	182,900	42.2	Plant upgrade Sedimentation Activated sludge Sludge dewatering	—	Planned	16.7
4. Levoca	12,700	14,100	4.9	Sludge dewatering	—	Planned	0.2
5. Sabinov	8,400	60,000	6.5	Sludge thickening	—	Planned	0.1
6. Lipany[a]		13,000	3.8		—	Planned	1.4

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Table 10 (continued)

Plant Name	Design Population	Residential Equivalent	Design Capacity m^3/day x 1000	Type of Facilities	Year Work Started	Status	Estimated Cost to Complete US$ x 10^6
13. Krompachy	9,300	22,000	5.9	New treatment plant Sedimentation Activated sludge Sludge digestion Sludge dewatering	1990	Under construction but stopped	2.1
14. Spisske Vlachy	10,000	10,000		New treatment plant	—	Planned	3.6
15. Gelnica	7,900	10,000	3.1	New treatment plant	—	Planned	8.9
							82.8

Note

(a) Plants numbered 7 through 12 are small and not considered significant enough to warrant listing.

2.1.7 Krompachy

The Krompachy WWTP is currently under construction and is approximately three-quarters completed. Site activity has stopped, however. The plant is estimated to be about half finished, and additional funds to complete the WWTP are reportedly unavailable. It was begun in 1990 and is intended to have a design capacity of 68 L/s (5,900 m^3/day, sufficient to serve 22,000 people. It was designed to treat municipal sewage only to secondary levels. The SEZ (Slovak Electrotechnical Enterprise) has recently inquired about discharging to the new municipal plant. SEZ's flow rates are acceptable but the quality of its discharge remains an issue.

The Kovohuty Krompachy copper smelter now is building a new treatment plant for its own sanitary and process wastes. The choices it has available are as follows:

- use the new industrial treatment plant as a pretreatment facility before discharging to the municipal wastewater treatment plant;
- use the new industrial treatment plant to treat fully all wastewater and discharge directly to the Hornad; or
- use the new industrial treatment plant to treat process wastewater only, discharge to the Hornad, and pipe sanitary wastewater to the municipal WWTP.

If the municipal WWTP can be placed into operation at an early date, it is suggested that the first option be pursued if it is determined that pretreated smelter plant wastewater can be effectively treated there. The hydraulic capacity of the WWTP should be adequate.

The estimated cost to complete the Krompachy WWTP is about $US 1.31 million. This estimate does not include changes in processes required to treat industrial wastewater. An additional amount would be needed to reconstruct sewers.

2.1.8 Spisske Vlachy

Spisske Vlachy has no WWTP, but one is planned to serve 10,000 people. No industries will discharge to the plant.

It is estimated that the cost to construct a secondary WWTP for Spisske Vlachy will be $US 3.6 million, plus another $US 2 million for a wastewater collection system. The VVAK district director considers Spisske Vlachy to be a "hot spot" because of the impact of raw sewage discharged directly to the Hornad.

2.1.9 Gelnica

A wastewater collection system has been constructed in Gelnica, and a new WWTP has been planned but not built. The WWTP is planned to have a secondary treatment capacity of 3,100 m^3/day.

It was reported that the cost to construct the new Gelnica WWTP would be about $US 8.9 million.

2.2 Municipal Water Supply Systems

The Hornad basin in Slovakia has 82 municipal water supply systems serving 487,000 people (74 percent of the basin's population) in 127 settlements with piped water. All of these systems are operated by the VVAK, headquartered in Kosice. The 127 settlements represent 38 percent of the total number of settlements in the Hornad River basin.

The VVAK produces an annual drinking water supply for the basin of 74.5 million m^3, or 2,362 L/s, of which 38 percent (880 L/s) is from surface sources. Water distribution network length totals 1,660 km, and VVAK operates 21 water treatment plants in the basin with a total capacity of 624 L/s. About 26 percent of the drinking water supplied in the basin can receive treatment.

In 1991, 54.7 million m^3 of water was sold for household, industrial, and other services. This amount represents 73 percent of production. Household usage was 37.1 million m^3, or 208.7 L per person per day.

Most of the water supply systems in the Hornad basin are considered too small to have significance for this report. Therefore, only those settlements with 5,000 or more people are listed in Table 11. Nine such settlements are listed (one with a population of 4,993), which have a total population of about 410,000, or 62.5 percent of the basin's population.

2.2.1 Kosice

For Kosice and neighboring settlements, water is provided from a variety of sources, as described in Section 1.2. Bulk surface water is provided by the Bodrog-Hornad River Basin Authority (PBaH in Slovakian), and VVAK pumps the water through transmission mains to the city. About half the 1,500 L/s average daily demand is provided from surface supplies; the rest comes from groundwater sources. An estimated 25 to 28 percent of the water produced is lost by leakage and wastage between the water treatment plants located at the two surface water reservoirs and the entrance to the distribution system. There is reported to be some chlorination of the distribution system, but no residual chlorine was indicated.

2.2.2 Presov

For Presov and its nearby settlements, 90 percent of raw water is from wells north of Sabinov on the Torysa, and 10 percent is from a surface water intake at Tichy-Potok. Consideration has been given to the construction of a new water supply reservoir near Tichy-Potok, and now a transmission main is in place. If and when completed, this new source would provide a 700

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Table 11

Inventory of Municipal Water Supply Systems in the Hornad River Basin

Settlement	Watershed	Type of System	Population		Distribution System Length, km	Treatment Provided	Water Demand, L/s
			Total[(a)]	Served			
Kosice	Hornad	Multiple settlements	234,800	233,200		groundwater chlorination	1,500
Presov	Torysa	Multiple settlements	87,789	83,100		surface water, 2 WTPs	645
Spisska Nova Ves	Hornad	Multiple settlements	39,187	38,100		groundwater chlorination	225
Krompachy	Hornad	Multiple settlements	8,241	8,200		surface water, 1 WTP	
Gelnica	Hornad	Multiple settlements	6,278	6,100		surface water, 1 WTP	
Levoca	Hornad	Multiple settlements	12,681	12,600			
Sabinov	Torysa	Multiple settlements	10,655	8,700			
Lipany	Torysa	Multiple settlements	5,514	5,000			
Smizany	Hornad	Multiple settlements	4,993	4,900			
TOTAL			410,178	399,900			

<u>Note</u>

(a) 1991 census data

L/s regional supply, including Kosice. A new water treatment plant would be constructed at the new reservoir.

Surface water is now treated at the source, and groundwater is disinfected with chlorine.

2.2.3 Spisska Nova Ves

For Spisska Nova Ves and its interconnected neighbors, about half of raw water comes from the Hornad River upstream of the city. However, river water quality deteriorates during certain periods (especially in the spring) for reasons outlined earlier in this report such that the water treatment plant becomes overloaded. In addition, the yield in the river reportedly is often too low to meet the demands of the city. No stream flow regulation occurs above Spisska Nova Ves to maintain safe yields. VVAK has requested studies on importing water from another basin.

The water treatment plant for river waters was originally designed with a capacity of 150 L/s, but only 100 L/s is now allowed. Water demand averages 225 L/s, with a maximum day (i.e., the total highest usage day of the year) of 317 L/s. Thus, Spisska Nova Ves has neither a safe nor an adequate drinking water supply.

2.2.4 Other Settlements

It is reasonable to assume that the problems associated with the adequacy and safety of municipal water supplies for the other significant settlements in the basin are similar to those described above. All of the systems serve multiple settlements.

2.3 Industrial Sources

2.3.1 Overview

The recent political changes and subsequent economic slowdown in Eastern and Central Europe have had a significant impact on the industries of this area. Production levels, particularly in the mining industry, have fallen drastically. However, the VSZ iron works at Kosice, which is the major producer and employer in the area, is working at almost 70 percent of its capacity and appears to be in good fiscal health.

The basin's industrial plants have wastewater treatment facilities that generally perform well in terms of effluent quality. The recent drop in industrial production has resulted in a parallel drop in emissions and, therefore, has improved the control of point sources. Although the wastewater point sources are manageable, the basin has a large number of solid-waste and hazardous-waste sites that potentially pose a great environmental risk. The available data on priority pollutants—particularly toxic organics—are very limited in all media, including stream flows, industrial and municipal point emissions, groundwater, soils, and sediments. Contamination of surface water and groundwater by mercury and other heavy metals is already documented to some extent, but many other priority pollutants may be present at unacceptable levels in all media. A very high priority for the Hornad basin is documentation of the extent of this type of pollution.

2.3.2 Description of Industries and Their Impact

A list of the major industrial point sources in the Hornad basin is given in Table 12. The industries are discussed below, starting with those affecting the upper reaches of the Hornad basin and following the flow of the Hornad to the Kosice area. The major industries discharge to the Hornad either directly or through small creeks. The major tributaries of the Hornad, Torysa, and Hnilec rivers have relatively small industries discharging to them. Indirect dischargers are concentrated mainly in the Kosice area.

Upper Hornad Area

The industries in this agricultural and mining region include a canning and distillery plant at Levoca on Levocsky Creek and some relatively small machinery plants.

The major industrial operation is the Zelezorudne Bane (Mining) Works in Rudnany. Both iron and copper ores are mined and processed here. The ores are of the complex type and also contain mercury and silver. Production at Zelezorudne greatly depends on demand from VSZ. Copper ore is used by the smelting plant in Krompachy.

The company's mine tailings and wastewater are stored in a massive lagoon that is reported to cover an area of about 250,000 m^2. Lagoon capacity is continually expanded by adding height to the lagoon's earthen walls. Some effluent metals exceed limits but the mercury limit is generally met. Effluent is discharged to the Rudniansky Creek.

The impact of past mining and ore processing operations on the water quality in this area is significant. The underlying aquifer is contaminated with mercury and therefore is not used for water supply. In-stream water- and sediment-quality data show contamination with heavy metals. Figures 9 and 10 show profiles of the stream and sediment mercury and copper levels along the Hornad starting at the sampling station in Rudniansky Creek (sampling station 5) and downstream to Tahanovce near Kosice. (The sampling station on the Hornad after Rudniansky Creek is labeled 5X in Figures 9 and 10). (See Figure 8 for a map of the sampling station locations.) High mercury and copper levels in sediments in Rudniansky Creek are indicated. Similarly, high mercury levels are indicated at sampling station 14. This is due to its location right below the Ruzin Reservoir, where hydroelectric activity is great.

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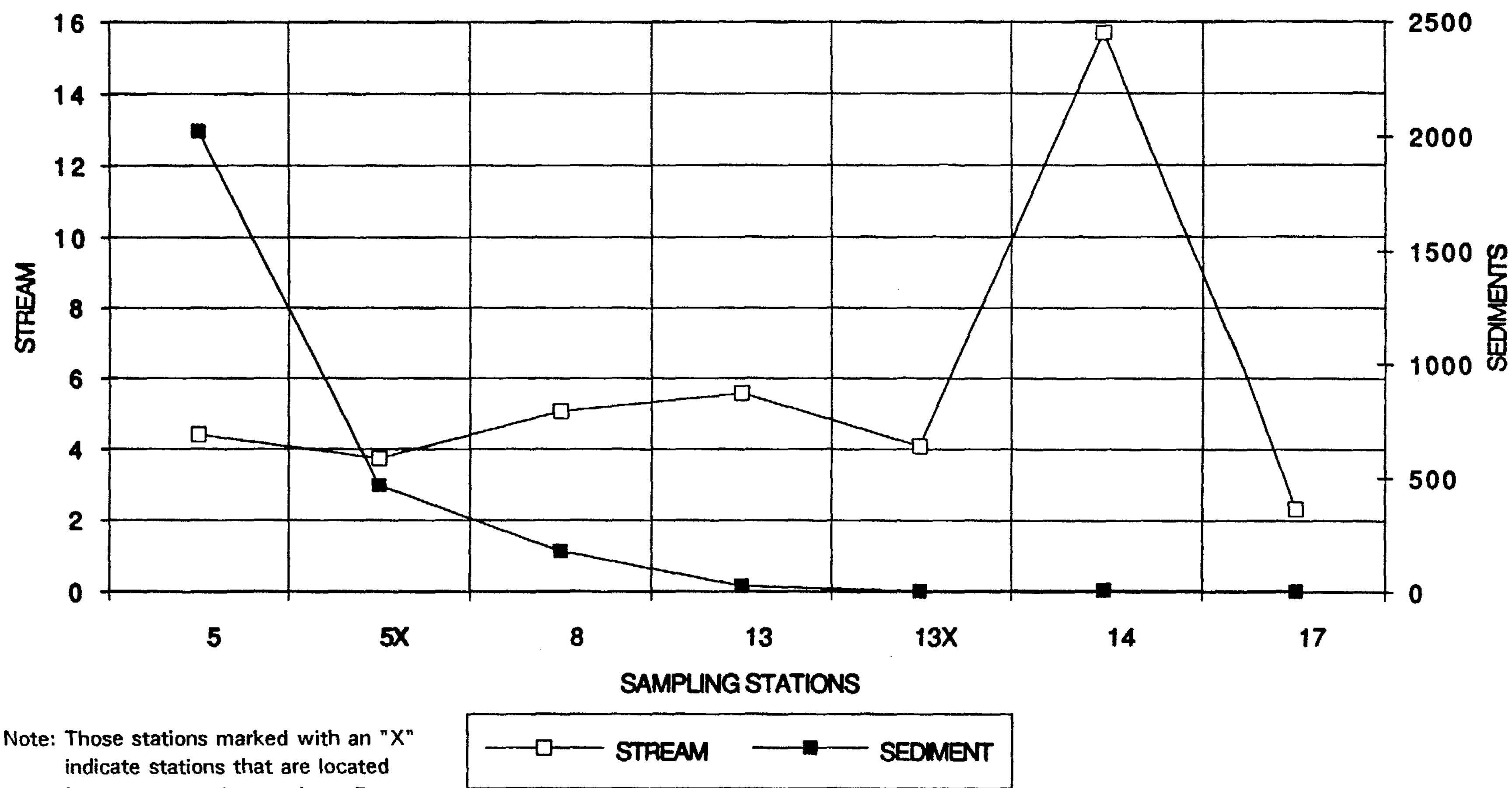
Table 12

Hornad Basin Point Sources

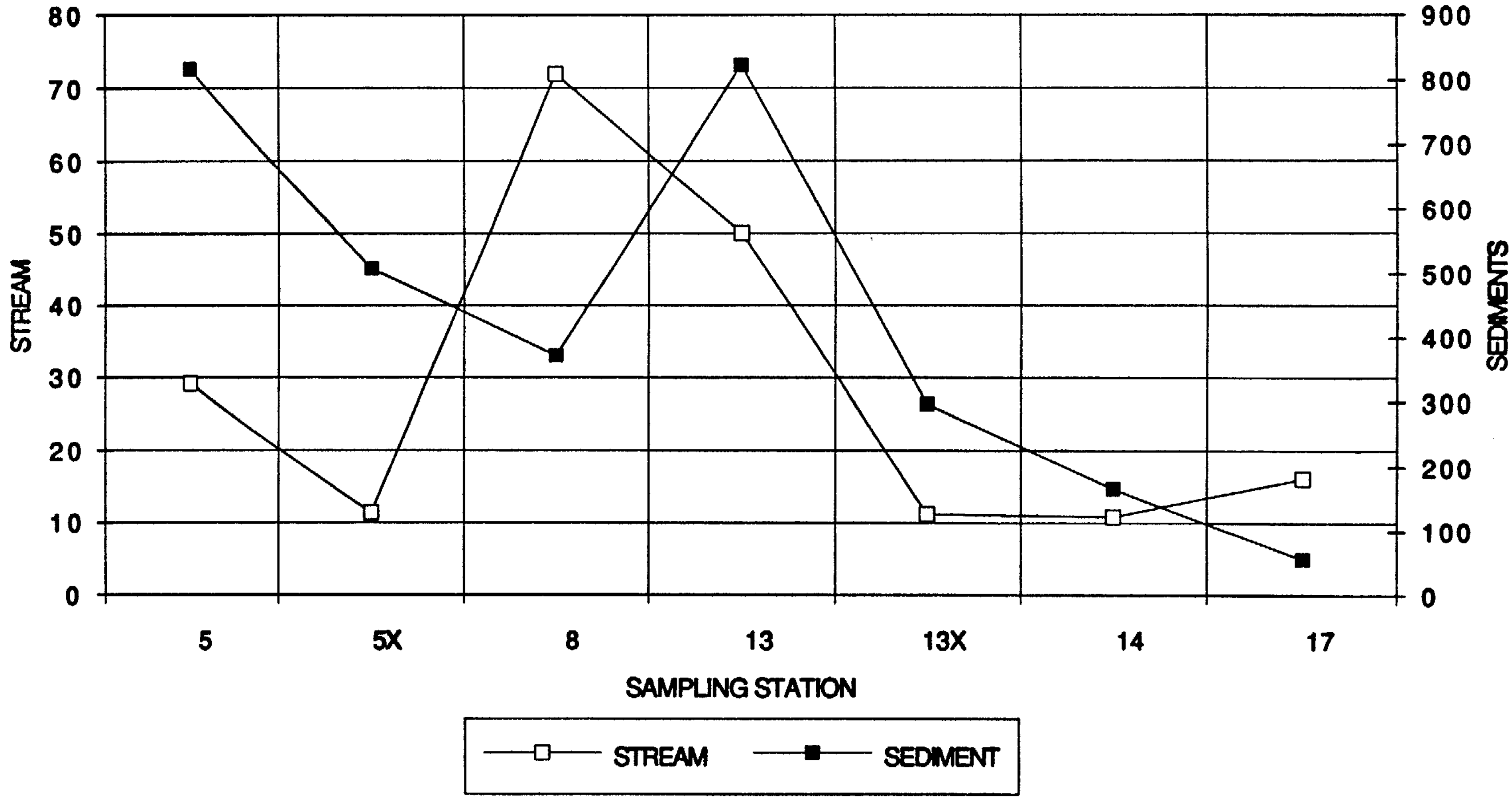
LOCATION/NAME	STREAM	FLOW 1000 M3/yr	EFFLUENT COD T/yr
MUNICIPALITIES			
KOSICE	HORNAD	59919	11983
PRESOV - SOLIVAR	TORYSA	12299	3197
SPISSKA NOVA VES	HORNAD	9145	914
SABINOV - ORKUCANY	TORYSA	2523	252
LEVOCA	LEVOCSKY	1867	112
LIPANY	TORYSA	568	48
KROMPACHY	SLOVINSKY	532	170
GELNICA	HNILEC	394	126
PRAKOVCE	HNILEC	378	170
RUDNANY	RUDNIANSKY	220	35
S. MICHALANY	TORYSA	158	94
KISOVCE	GANOVSKY	145	58
S. PODHRADIE	MARGECIANKA	136	54
MARGECANY	HNILEC	126	75
INDUSTRIES			
KOSICE - VSZ STEEL MILL	SOKOLONVSKY	27421	1508
KOSICE HEAT PLANT	HORNAD	7030	182
KH KROMPACHY COPPER SMELTER	HORNAD	1735	78
SOLIVAR - SALT	SEKCOV	1440	86
KOSICE - VSZ STEEL MILL (SO4)	HORNAD	950	23
S.N. VES - URANIUM MINE	HOLUBNICA	700	2
S.N. VES - ZB ORE PROCESSING	RUDNIANSKY	700	12
S.N. VES - ZB ORE TAILINGS DAM	SLOVINSKY	330	13
S. MICHALANY - PHARMACEU.	TORYSA	330	29
SENA - BUILDING	SOKOLIANSKY	280	7
LEVOCA - CANNING	LEVOCSKY	260	260
KROMPACHY - SEZ ELECTRICAL	HORNAD	190	15
PRAKOVCE - MACHINERY	HNILEC	187	9
PRESOV -	SEKCOV	150	9
SMOLNICKA HUTA	SMOLNIK - 1	132	3
PRESOV - HYDINARSKE	DELNA	131	78



Note: Those stations marked with an "X" indicate stations that are located between two other stations. For example, station 5X is nearby station 5.

Figure 9

Average Mercury Levels in the Hornad, 1985-90, Micrograms per Liter



Note: Those stations marked with an "X" indicate stations that are located between two other stations. For example, station 5X is nearby station 5.

Figure 10

Average Copper Levels in the Hornad, 1985-90, Micrograms per Liter

Krompachy Area

The major industries in the Krompachy include the second mining operations of Zelezorudne Bane Works at Slovinky, the Krompachy copper smelter plant, and the SEZ electrical components plant.

The Zelezorudne Bane Works at Slovinky mines and processes copper ore. Arsenic and mercury are associated elements. The company's maximum production used to be 250,000 metric tons per year, but as of late 1992 was only half that. Ore is not considered economical and the operation may not survive. Tailings and wastewater are settled in a lagoon that has been built up higher than 60 m with settled solids. Effluent is discharged to Slovinky Creek.

The Krompachy copper smelter plant processes copper and manganese ores and scrap copper. Products include copper powder, electrolytic copper, and manganese. Beginning in 1993, 8-mm copper wire will be produced using Italian technology and will be the plant's main product. The plant's capacity is 30,000 tons per year. Management says the firm's business outlook is reasonably good. Wastewater from the plant is neutralized and settled before discharge to the Hornad.

Sludge from the plant's wastewater treatment is stored in a lagoon next to the Krompachy municipal dump, which lies directly adjacent to the Hornad streambed. The entire waste dump site appears to lie within the floodplain, and no precautions appear to be taken to prevent runoff from entering the river directly.

The SEZ plant is located next to the Krompachy copper smelter. Its products include electrical appliances and equipment. Plating operations are performed whose wastewater contains zinc, cadmium, and cyanide. An existing treatment plant at the smelter does not always meet acceptable discharge limits, but new WWTP is under construction as part of the new plating shop. In 1989, the plant employed 2,400 workers; employment in late 1992 was down to 1,800. The smelter's managers say they are operating one of the few successful enterprises during the country's economic transition period.

Stream and sediment quality profiles taken from the smelter show an increase in copper levels at sampling station 8, which is downstream of Krompachy. Samples taken in the Ruzin Reservoir (sampling station 13X) show significant drops in copper levels.

Kosice Area

The basin's food industry is concentrated in Kosice and discharges to the area's municipal system, but the major direct discharger is VSZ (iron works). The central heating plant is also a major discharger.

VSZ is the major industry and employer in Kosice. Production by the mill in late 1992 stood at almost 70 percent of its capacity. Management says the company's business outlook is good. A new WWTP was completed several years ago and is operating satisfactorily. Discharge is to Sokolonvsky Creek, which enters the Hornad in Hungary. Sludges are stored in a lagoon, but a sludge dewatering plant is planned. Phenol-bearing wastewater is treated at a separate treatment plant at the site of the municipal treatment plant. Plans are under way to construct a new treatment plant for phenol wastewater to improve efficiency.

Other Areas

Stream and sediment samples taken at the downstream end of Hnilec River (sampling station 13) indicate elevated copper levels. The Prakovce Machinery plant and other smaller machinery plants are located in this basin.

The major industries in the Torysa subbasin are the S. Michalany Pharmaceuticals plant, a salt mining and processing plant in Solivar (near Presov), and machinery plants in Presov on the Sekcov tributary.

A high priority concerning industrial and hazardous waste in the basin is further defining the extent of the problem so that risks can be assessed and compared more accurately. Complicating this endeavor is the insufficient amount of analytical information available on priority pollutants. Existing data generally are limited to heavy metals.

The industrial sites that are known to pose significant hazardous-waste problems are Zelezorudne Bane Works at Slovinky and Rudnany, the Krompachy copper smelter, and VSZ.

Chapter 3

INSTITUTIONAL AND FINANCIAL ISSUES

3.1 Sector Organization

At present, the water and wastewater sector in Slovakia remains highly centralized, although responsibility is shared among several different ministries and authorities. The main ministries are the Ministry of Environment (MOE) and the Ministry of Soil Management (MSM), formerly the Ministry of Forests and Water. The MOE is relatively new and is gradually taking over authority at the local level for monitoring water quality, setting fines, and granting pollution permits—functions previously performed entirely by the river basin authorities. The river basin authorities, which are under the jurisdiction of the MSM, remain responsible for water resource management, development of bulk water supplies, and collection of water-use (severance) fees and pollution fees. The delivery of water and sewerage services is vested in regional water works authorities (also under the MSM), which provide water supply and wastewater services to communities and industries on a monopoly basis.

The Hornad basin falls under the jurisdiction of the PBaH and is served by the VVAK. Table 13 summarizes the roles and responsibilities of the key actors in the sector.

Although decentralization in water and waste service delivery at the local level has often been discussed, the past system continues in force with these services managed by the regional water works authorities. Water and sewer rates are still set uniformly across Slovakia (by the MSM) and are currently at levels well below cost recovery. Table 14 shows the tariff structure as of 1992. Water works authorities may buy bulk water from the river basin authorities and sell water to residential and commercial/industrial consumers at different rates. In addition, the river basin authorities collect a severance tax (termed a "water-use fee") on all users of the natural water supply in the area.

The continuation of artificially low consumer rates promotes inefficient use of water (overconsumption) and makes realistic water development planning difficult. It also places an added burden on wastewater treatment because treatment plants must be oversized to accommodate high water usage.

Table 13

Summary of Roles and Responsibilities

	Organization	Responsibilities
1.	Ministry of Environment (MOE)	Overall environmental quality control, policy, standards, norms, and enforcement. Coordination and management of long-range policy, legislation, and donor activity.
	Environmental Inspectorates	Control of activities related to environmental protection, including sampling and inspections of air, water, soil, and solid waste. A part of the MOE.
	District Environmental Offices	District-level offices for determining water-quality policy and enforcement actions, granting pollution permits, and setting taxes and fines. A part of the MOE.
	Hydrometeorological Institute	Data collection and analysis, performance monitoring reporting, and computerized database maintenance.
2.	Ministry of Soil Management (MSM); formerly Ministry of Forests and Water (MFW)	Water resources management; coordination of water resource use and land use; basin management; and river pollution abatement and control.
	River Basin Authorities	Administration of water resource quantity and use. Linked to the MSM but incorporated with a board. Conduct water-quality testing with most of the larger laboratories in Slovakia for all entities, grant water use permits, share in fines and sanctions with the MOE, and supply raw water to drinking water authorities.
	Regional Water Works Authorities	Purification, distribution, and commercial management of domestic water, and management of wastewater treatment capacity and infrastructure. Linked to the MSM.
3.	Water Research Institute	Semi-autonomous research institute; conducts studies in water resource planning, master plans, technical studies on water quality and the environment, and river basin modeling.
4.	Project Organizations	Engineering construction: Hidrocounsult, design engineering; being privatized.

Source: Dan Edwards, Point Source Pollution in the Danube Basin, Volume II: Institutional Studies of Bulgaria, the CSFR, Hungary, and Romania. Prepared for the Europe Bureau, U.S. Agency for International Development. WASH Field Report No. 374, July 1992, p. CSFR-5.

Table 14

Water and Sewer Charges, 1992

Title	How Applied	Rate Structure
1. Water use (severance)	Collected by PBaH from all users of raw water, including irrigation, hydropower, and industry	0.92 Kcs per m^3 for all classes
2. Bulk water supply to regional water works	Collected by PBaH for all water provided to VVAK	0.92 Kcs per m^3
3. Residential water/sewer charges	Collected by VVAK from all metered customers	1.50 Kcs per m^3 each for water supply and sewer
4. Commercial/industrial water/sewer charges	Collected by VVAK from all metered customers	5.25 Kcs per m^3 for water supply; 4.25 Kcs per m^3 for sewer usage

3.2 Options for Institutional Reform

Slovakia's central government is seeking to reduce the level of subsidy in the sector and to institute more managerial efficiency. During the next 12 months, it fully intends to restructure the country's water delivery institution, but has not yet decided how it will do so.

Thus far, one proposal has been made to restructure the five regional water works authorities by setting them up as five joint-stock companies under a single holding firm. Under this arrangement, the "privatized" authorities would charge rates sufficient to make a reasonable profit. Because the government is being pressured to maintain a uniform rate structure across the country, some of the five companies would be profitable while others would require cross-subsidization from the profitable companies. It is unclear how this privatized conglomerate would cover new capital investment, however. Unless consumer rates were allowed to rise tremendously, some form of subsidy would continue to be required from the state for this purpose.

The above option would increase rates to more realistic (but probably not full cost-recovery) levels, and reduce the level of operating subsidy needed from the central budget. It would not necessarily increase managerial efficiency, however, as the five companies would still be monopoly suppliers. Furthermore, this option gives no more control to local governments and brings no additional resources into the sector, meaning that central government grants for capital investment will likely continue to be needed. It is also unclear just how the transfer from state ownership to the "privatized" companies will occur and who will own the water and sewer system assets. In summary, this option would not significantly restructure the delivery system.

Other restructuring options might be much more radical. For example, each regional water works authority could be broken into smaller units, such as district authorities. (In the Hornad basin, units smaller than the district level would probably not make sense, given the manner in which the infrastructure has already been developed.) Such authorities could be operated as private companies, as local public authorities (perhaps municipally owned), or as state enterprises.

Under the above scenario, municipal governments could be given more say in how and where new investments are made; in exchange, municipalities would be expected to assume more of the financial burden for new investments (devoting some fraction of the expanded revenue base they should receive under proposed fiscal reforms). Placing more financial responsibility on municipal governments would lower the need for national subsidies.

If district authorities are created (and given monopoly status), some form of rate-setting regulation should be maintained outside of the authority. A rate-setting board would probably need to be established, with representation from local governments as well as from state agencies. Such a regulatory board would take into account the costs of providing services in each authority, as well as comparative costs of other district authorities in the region. Such a system could even introduce elements of competition by inviting outside firms to bid periodically on management contracts of the district authorities.

The East Slovakia region may serve as a pilot project for sector reorganization at the local level, although it has several unique problems. The main problem is that the buildup of long-term pollution in the basin requires that drinking water be supplied on a regional basis, much from outside the basin. Therefore, bulk water supply must remain in the control of some form of regional authority.

3.3 Sector Finance

Slovakia's water and wastewater sector is highly subsidized, both for operating expenditures and for capital investment. Although detailed figures have not yet been made available to the WASH team, the central government provided operating subsidies amounting to about 200 million Kcs in 1992. Of this total, about 150 Kcs, million, or 75 percent, went to the VVAK. The MSM is proposing to raise tariffs in 1993 to reduce this operating gap, but still anticipates the operating subsidy requirement will reach 150 Kcs million this year.

Capital investment flows into the sector by two principal ways: the Environmental Protection Fund (which is controlled by the MOE) and capital grants to the regional water works authorities. Both of these sources are highly dependent on annual budget appropriations from the central government and are in considerable flux. The MSM provided about 700 million Kcs to regional water works authorities in 1992 and proposes almost doubling that amount to 1.3 billion Kcs in 1993. On the other hand, the Environmental Protection Fund is likely to drop from its 1992 amount of 1.46 billion Kcs to an uncertain amount in 1993. (At this time, it is difficult to say with any certainty just what investment levels are likely to be, because the Slovak Republic is undergoing a substantial revamping of its overall revenue base.) With the restructuring of the regional water works authorities, however, it is likely that the Environmental Protection Fund will become the main source of capital investment funds for the sector.

The Environmental Protection Fund is capitalized by pollution fees and fines as well as by direct budgetary support from the central government. Indeed, in 1992, about 65 percent of the Fund's revenues came from the central budget (see Table 15), while the remainder derived from a mixture of pollution fees, water use taxes (severance taxes), and fines. The bulk of the fees originates from water use and water pollution fees—about 30 percent of the total.

Table 15

Sources and Applications of Environmental Protection Fund, 1992

Fund Sources	Amount (million Kcs)	Total (%)
National budget	928	65.1
Water use taxes	42	2.9
Water pollution fees	370	26.0
Pollution fines	25	1.8
Air and waste fees	60	4.2
Total	1,425	100.0

Fund Expenditures	Amount (million Kcs)	Total (%)
Sewerage and wastewater treatment	883.4	60.5
Water supply	316.4	21.7
Air pollution control	177.2	12.2
Solid waste	76.1	5.2
Nature conservation	0.8	0.1
Other	4.9	0.3
Total	1,458.7	100.0

Source: Ministry of Environment

Table 15 also shows that the overwhelming percentage of the fund's expenditures goes to the water and wastewater sector—about 60 percent for sewerage and waste treatment and about 22 percent for piped water projects.

As noted above, in addition to the Environmental Protection Fund, financial support also flows through the MSM to the regional water works authorities. Financial conditions among the regional water works authorities differ considerably because their operating costs vary (although their fee structures are uniform). VVAK has relatively high costs given that much of its water must come either from outside of the basin or from far distances within the basin. Other regional authorities are reported to have lower cost structures.

One of the main problems with the current system of capital investment financing is that the demand for funds is about 10 times greater than the supply, based on grant applications received by the Environmental Protection Fund. However, because these applications are for free grant resources, parties that are not especially needy may apply, making it difficult to know what the level of real need is. A second problem with the current system is that grant funds are rationed in such a manner that construction of new facilities is spread over a number of years. The WWTP at Presov, for example, has been under construction for 15 years. Such practices are incredibly wasteful, running up final costs and delaying the benefit of the investment stream.

3.4 Use of Debt Financing in the Sector

Slovakian government officials are expressing a growing interest in using loans for financing sector investments, especially because the amount available to the Environmental Protection Fund is inadequate and likely to decline. Indeed, there has already been some limited experimentation with lending for sector investments to local governments. This lending has largely served to reveal current problems with such loans. For example, Poprad (in the VVAK service area but just outside the Hornad basin) attempted to negotiate a loan for 280 million Kcs from a consortium of three banks, but could not provide adequate guarantees for the loan.

The increased use of debt has two principal aims: 1) to raise the total amount of investment capital available to the sector by an infusion of funds from international lenders (e.g., World Bank and the European Bank for Reconstruction and Development); and 2) to provide capital to end users as loans rather than as grants.

In the current economic climate, Slovakia's central government is mainly interested in incurring debt only insofar as the obligation can be passed on to the end users (i.e., the water/sewer consumers or the local authority), a process called "on-lending." Before assuming international loans for the sector, therefore, the government must develop a formal system of on-lending. The MOE has been examining alternative structures for the Environmental Protection Fund that would allow it to make loans and grants simultaneously. Three basic models for the fund are now under consideration:

- A straight grant and loan disbursement account in which the total amount available to the fund each year would be disbursed as either grants (not repaid) or loans (to be repaid). Repayments would be refunded to the central budget. This approach would keep the fund largely dependent on annual budget appropriations, as it is now.

- Grant and loan revolving fund. Loan repayments would stay (revolve) within the fund, adding to its capital (and lessening future demands on the central budget while freeing the fund somewhat from the uncertainties of the annual budget appropriation).
- "Leveraged" grant and loan revolving fund. The amount available for lending would be increased by borrowing against fund reserves. This approach is modeled on several U.S. state-level environmental revolving funds.

In the U.S., "leveraged" revolving funds typically raise from two to three times the original fund capitalization for lending at rates that are well below market rates. The amount of leverage depends on how much is kept in the reserve fund, and on how much subsidy is provided at the on-lending rate.

Individual municipalities are showing considerable interest in also setting up some type of municipal development fund that would provide loans for local infrastructure. The municipalities are promoting this concept, but as yet no clear consensus has been formed on how such a fund might be created. There is also some interest in linking such a municipal development fund with the Environmental Protection Fund, especially if the latter can be used to provide loan guarantees for the former. At present, the Environmental Fund cannot make loans or provide loan guarantees, so new legislation would be required for either activity.

3.5 The Role of Municipalities in the Sector

As noted in Section 3.2, the municipal governments could become more directly involved in water and wastewater services as the sector restructures. The first concern with such an effort is whether the municipalities will be given any responsibility for service provision and/or financing. The second concern is whether they will have adequate financial resources to play a meaningful role.

Slovakia's municipal finances are as much today in flux as the structure of its water supply and sanitation sector. Proposed fiscal reforms should give local governments a revenue base consisting mainly of the following:

- a formula-based allocation of part of the national income tax—forecast to be about 40 percent of local revenues;
- sharing of the property tax with the jurisdiction from which it is collected—forecast to be about 25 percent of local revenues;
- earmarked subsidies from the central government—15 percent of total local revenues; and
- local fees and charges amounting to about 20 percent of the total.

Because the bulk of these funds derives from centrally collected taxes, the level of resources provided to municipalities will depend largely on national revenues. These national taxes are newly instituted and their yield is not readily predictable at present. So far, anecdotal evidence from municipalities during 1992 suggests that the current transition has been accompanied by large drops in revenue sharing from the central government. The municipal governments have coped with this decline mainly by cutting capital investments. This suggests that municipal governments may not have funds to devote directly to the water and wastewater sector and that they may not be good candidates for borrowing in the near term.

Chapter 4

POTENTIAL PROJECTS

4.1 Summary Analysis

Two overriding issues determine the potential for effective water-quality improvements in the Hornad basin. The first is long-term contamination from mining and ore processing in the central part of the basin; the second is the poor state of municipal wastewater treatment in every major town and city in the basin.

The long-term pollution from mining and ore processing waste in the area from Rudnany to the Ruzin Reservoir below Krompachy (mainly heavy-metal sediments) has rendered this stretch of the Hornad River unusable for drinking water supply. Although some highly productive bank-filtered wells are situated below this area (about 30 km downstream of the Ruzin Reservoir dam), most of the water supply for the lower Hornad settlements (which contain about half of the total inhabitants of the basin) comes from outside the basin. The government has adjusted to the long-standing pollution by developing a drinking water supply infrastructure that moves water over long distances. This approach is costly and has left the area with the highest costs of water services in the country.

The poor performance of municipal wastewater treatment adds to the problems of industrial and mine pollution. All municipal plants in the basin are overloaded, and plant expansions and replacements are being constructed piecemeal at a slow pace. Part of the problem is that realistic water tariffs have not yet been introduced, so users have no financial incentive to conserve. In addition, much of the industrial loading on municipal waste treatment plants in the basin comes from agro-processing companies that are surviving (until now) the country's economic restructuring. As a result, there has not been much reduction in industrial emissions to municipal waste treatment plants, though such reduction is common in surrounding countries.

The following sections describe the major problems in wastewater emissions the WASH team has identified in the Hornad basin. A summary table of the problems and potential solutions is presented in Table 16.

4.2 Municipal Wastewater Abatement Projects

All existing Slovakian wastewater treatment plants (WWTPs) in the basin are overloaded, and several medium-sized towns discharge raw sewage directly into the Hornad and its tributaries without treating it at all. While all towns of any size have some documented need for WWTP upgrading or construction, four problem sites stand out:

Table 16

Danube River Basin Environmental Program, Hornad River Basin, Slovakia:
Potential Pre-Investment Program

Target Problem	Type of Exposure	Population Affected	Potential Solutions	Financial Feasibility
INDUSTRIAL SITES				
1. VSZ WWTP upgrading: phenols and oil sludges	Contamination of Hornad R. from sludge storage and phenols	Population downstream to Miskolc: ca. 250,000	1. Construct biological treatment facility 2. Construct oil sludge incinerator	Total costs: $44 million. VSZ profitable.
2. Rudnany Mine Sludge Lagoon	Potential groundwater contamination in locality; potential contamination of upper Hornad	Population downstream to Ruzin Res: ca. 120,000	1. Stabilize sludge lagoon 2. Monitor groundwater	Costs not known; mine reducing output but will survive.
3. Krompachy Copper Smelter	Pretreated waste water discharge directly into Hornad; potential contamination from onsite sludge lagoon	Population downstream to Ruzin Res: ca. 100,000	1. Upgrade treatment facility 2. Remove sludge	Costs not known; operation profitable; already making $20 million investment for air pollution equipment.
4. Krompachy Municipal Waste Dump	Surface runoff directly into Hornad	Population downstream to Ruzin Res: ca. 100,000	1. Stabilize dump 2. Monitor runoff 3. Relocate dump and control new site	Costs not known; municipality has no funds for investment.
5. Mercury deposits in Ruzin Reservoir	Potential aquifer contamination in lower Hornad, especially in low-flow augmentation	Population downstream: ca. 400,000	1. Stabilize deposits	Costs not known.

Table 16 (continued)

Target Problem	Type of Exposure	Population Affected	Potential Solutions	Financial Feasibility
MUNICIPAL SITES				
6. Presov WWTP overloaded	Contamination of Torysa R. affecting irrigation and bank filtered wells	Population downstream: ca. 300,000	1. Complete new WWTP already under way	Est. cost to complete: $18 million. Municipality has no funds but work proceeding with local credit from future funding.
7. Krompachy WWTP	Contamination of Hornad R. affecting bank filtered wells	Population downstream to Ruzin Res: ca. 100,000	1. Complete secondary treatment plant (now stopped) 2. Reevaluate design	Est. cost to complete: $2.1 million. Municipality has no funds to complete.
8. Spisska N. Ves WWTP overloaded	Contamination of Hornad R. affecting bank filtered wells	Population downstream to Ruzin Res: ca. 150,000	1. Add WWTP capacity 2. Rehabilitate existing WWTP 3. Pretreat industry wastewater	Est. cost to expand and rehabilitate: $17 million. Municipality has no funds.
9. Kosice WWTP overloaded and expansion under way in phases	Contamination of Hornad R. affecting bank filtered wells and water quality entering Hungary	Population downstream to Miskolc: ca. 250,000	1. Complete Phase II biological facility 2. Complete Phase III sludge processing 3. Build phenol facility at VSZ	Est. cost to complete both phases: $32 million. Possible co-finance of VSZ phenol plant. Candidate for IBRD-funded program.

- Kosice Municipality,
- Presov Municipality,
- Krompachy Municipality, and
- Spisska Nova Ves municipality.

4.2.2 Kosice Municipality Wastewater Treatment

Current emissions from the Kosice WWTP seriously degrade the water quality in the Hornad, not only reducing the usefulness of the aquifer below Kosice but ultimately threatening the drinking water supplies all the way to Miskolc, Hungary. Currently, the plant receives an average inflow of twice the capacity of its existing secondary treatment facilities. Sludge handling for the existing secondary treatment stage is also inadequate, with the sludge now being dumped rather than used in surrounding agricultural areas. In addition, the Kosice plant operates a partial treatment facility for phenol wastewater from VSZ that needs upgrading—most likely to be replaced by a facility built on-site at VSZ.

Priority components of an upgrading project for the Kosice WWTP would include completion of the phase II secondary treatment (biological) facility; completion of the phase III sludge processing facility and development of sludge use in agriculture; and construction of a phenol treatment facility at VSZ. Completing the first two components is estimated to cost about $US 32 million but that cost does not include rehabilitation or reconstruction of the wastewater collection system. Construction of the phenol treatment plant is discussed below.

The World Bank has initially identified the Kosice WWTP as a potential candidate for inclusion in a loan package it would fund. If plans proceed with a project preparation study of the Kosice facility, additional WASH involvement should not be needed.

4.2.3 Presov Municipality Wastewater Treatment

The existing WWTP at Presov is greatly overloaded. A replacement plant has been under construction since 1978 but still has not been completed. Additionally, questions remain about the adequacy of the replacement plant's design and the structural soundness and mechanical integrity of facilities installed during the protracted construction period.

Completing the Presov plant is a high priority because of the high loadings (including nitrates) it puts on the Torysa River. These loadings have already contributed to the shutdown of a number of bank-filtered wells along the Torysa south of Presov, as well as to the high nitrate levels found in the lower Hornad. The Presov plant may also serve as a good pilot project for improved sludge usage because the practice of monitoring sludge quality and applying it on agricultural land in the area is already in place.

The estimated cost of completing the WWTP is $US 18 million, but that amount might change pending a design review and an assessment of the adequacy of the partially completed facilities.

4.2.4 Krompachy Municipality Wastewater Treatment

Krompachy is the largest settlement in the Hornad basin without a WWTP in operation. Currently, sewage from its 8,241 residents and commercial establishments goes directly into the Hornad River.

A WWTP incorporating secondary treatment was started in 1990 along with a new main trunk sewer. Overall, this project is estimated to be about three-quarters completed. Funds needed to complete the plant (about $US 1.31 million) are reportedly unavailable. It lies adjacent to the copper smelter and the SEZ electrical equipment plant and could be used additionally to treat the sanitary wastewater from both. In addition, the municipal WWTP might be able to treat the industrial wastewater from the copper smelter after sufficient pretreatment at the plant. This possibility would have to be examined in more detail than the WASH team was able to provide during its initial assessment.

A more complete discussion of the Krompachy WWTP is provided in Chapter 5, under "Component 2.2" in Section 5.2.2.

4.2.5 Spisska Nova Ves Municipality Wastewater Treatment

Spisska Nova Ves's WWTP is overloaded, with its average daily flow now matching its design capacity. During the summer, when flows from a potato starch plant are high, the WWTP operates at well over capacity. Other industries in the town also contribute to very high COD levels that must be better controlled.

The plant also needs to improve sludge usage. It has recently installed sludge dewatering equipment but has problems getting farmers to use the sludge (which already meets acceptable levels of heavy metals).

The estimated cost to double the WWTP's capacity is estimated to be about $US 17 million.

4.3 Industrial Wastewater Abatement Projects

The potential industrial wastewater projects worth undertaking in the basin include two that address the needs of upgrading wastewater treatment at industrial plants and three that address problems of existing waste dump sites. These projects are as follows:

- upgrading the VSZ WWTP facilities for phenols and oil sludges,
- upgrading the Kovohuty, Krompachy, copper smelter WWTP facilities,

- securing the Rudnany mine lagoon,
- securing the Krompachy solid-waste dump site and copper smelter lagoon, and
- securing heavy-metal deposits in the Ruzin Reservoir.

4.3.1 VSZ Wastewater Treatment

As part of a comprehensive investment program to manage its waste stream better, VSZ has identified two targets as highest priority in the water sector: building a phenol treatment facility at VSZ (to replace the partial treatment facility at the Kosice WWTP) and building an incinerator for destroying oil sludges.

Both projects are already planned, and preliminary estimates put the total cost for both at about $US 44 million. However, financing for the projects has not yet been arranged. VSZ appears to be in reasonably sound financial condition and is expected to survive Slovakia's economic restructuring.

4.3.2 Kovohuty Copper Smelter

The Kovohuty copper smelter in Krompachy is currently discharging partially treated effluent directly into the Hornad. Its plans for further wastewater treatment depend on completion of the Krompachy municipal WWTP and a joint decision on whether the municipal plant can handle both the sanitary and the pretreated industrial effluent from the smelter. Sludge from the smelter's pretreatment facility is currently stored at the Krompachy municipal dump and is inadequately sited and monitored.

At present, there are no cost estimates for the various options that the smelter might adopt, nor is there a plan or cost estimate for securing the sludge lagoon. The smelter is currently investing about $US 20 million in air pollution (sulfur dioxide emissions) abatement, which has higher priority than wastewater abatement at the moment (see "Component 1.1" in Section 5.2.1).

The smelter is profitable and is expected to survive the nation's economic restructuring. Any proposals for wastewater facility investments should be done jointly with plans for the Krompachy municipal WWTP and waste dump (see below). At present, a study is recommended that examines these three issues together.

4.3.3 Krompachy Municipal Waste Dump

The Krompachy solid waste dump is located on the banks of the Hornad and also contains the sludge lagoon of the copper smelter (see above). At present, the dump does not control runoff or hazardous dumping. Additionally, it keeps poor record of its hazardous materials and fails to monitor groundwater in its immediate vicinity.

A study is recommended to assess the current situation in detail and to make proposals for securing and possibly removing the dump site to another location. At this point, costs for this project are unknown, and the municipality has no funds for its investment.

4.3.4 Rudnany Mine Sludge Lagoon

The Rudnany sludge lagoon stores the sludge from the wastewater treatment facilities at the Rudnany mine. It occupies an area of about 250,000 m^2. Ore and resulting wastewater are known to contain several heavy metals, including mercury. At present, it is unknown how much of an environmental threat the lagoon poses; however, serious questions prevail about the ultimate disposal of the vast amount of material in the lagoon, the structural integrity of the lagoon walls, and contamination of groundwater (although groundwater in the area is already known to be generally contaminated from centuries of mining activity).

A study is recommended to determine how much of an environmental threat the lagoon poses and to make proposals for any needed countermeasures. Costs for this project are unknown at this time.

4.3.5 Mercury Deposits in the Ruzin Reservoir

The Ruzin Reservoir captures mercury and other heavy-metal deposits in the Hornad flowing from the mining areas above Krompachy. Currently, there are extensive deposits, particularly of mercury, in the reservoir and in the upstream reaches of the Hornad. Sediment measurements indicate that mercury concentrations are highest where Rudniansky Creek (which drains the Rudnany mine) flows into the Hornad and that they steadily decrease all the way to the Ruzin Reservoir.

Given the extent of the reservoir's mercury deposits, it is unlikely that much can be done in the near term to deal with them. Nonetheless, the main threat to health that heavy-metal deposits pose here is potential contamination of bank-filtered wells used for drinking water supply just above Kosice. Consequently, these wells should be monitored continually. Costs for this project are unknown at this time.

Chapter 5

PREFEASIBILITY STUDY

5.1 Project Selection and Rationale

After reviewing the assessment data in Chapters 1 through 4 above and holding discussions with USAID and WASH representatives, the government of Slovakia selected the following for further prefeasibility work: the development of a project to deal with Krompachy's industrial and municipal wastewater pollution problems. The situation in Krompachy represents a challenging combination of pollution problems found throughout Slovakia, specifically the following:

- long-term industrial pollution (both air and water);
- municipal sewerage and WWTP needs (including how to complete partially built projects); and
- solid-waste sites that contain both municipal and industrial deposits, including industrial wastewater sludge lagoons.

The impact area of pollution sources in Krompachy extends far downstream. Additionally, the mining area of Rudnany upstream of Krompachy affects downstream waters. Both the Hornad River and the Ruzin Reservoir are highly contaminated with heavy metals and untreated sanitary sewage, which affect downstream drinking water supplies for about 400,000 people. The water supplies of the city of Kosice, for example, are adversely affected by this contamination, mainly in bank-filtered well supplies located downstream of the reservoir. Figures 11 and 12 provide a map of the area and a map of the prefeasibility study site, respectively.

The Ruzin Reservoir, which lies at the confluence of the Hornad and Hnilec rivers, is a multipurpose body of water built in 1968 with an effective volume of 58 million m^3. The reservoir supplies water for industry in the Kosice area, hydropower production, flood control, low-flow augmentation, and recreation. Its upstream end is located about 12 km below Krompachy, and the dam at Mala Lodina is about 56 km upstream from Kosice.

The Ruzin Reservoir cannot be used as a source of drinking water because of its highly contaminated state. In addition, it is reported to contain about 5 million m^3 of sediments contaminated with mercury, cadmium, nickel, and copper. As a result, drinking water for Kosice must be imported from as far away as the Starina Reservoir, which is 140 km away.

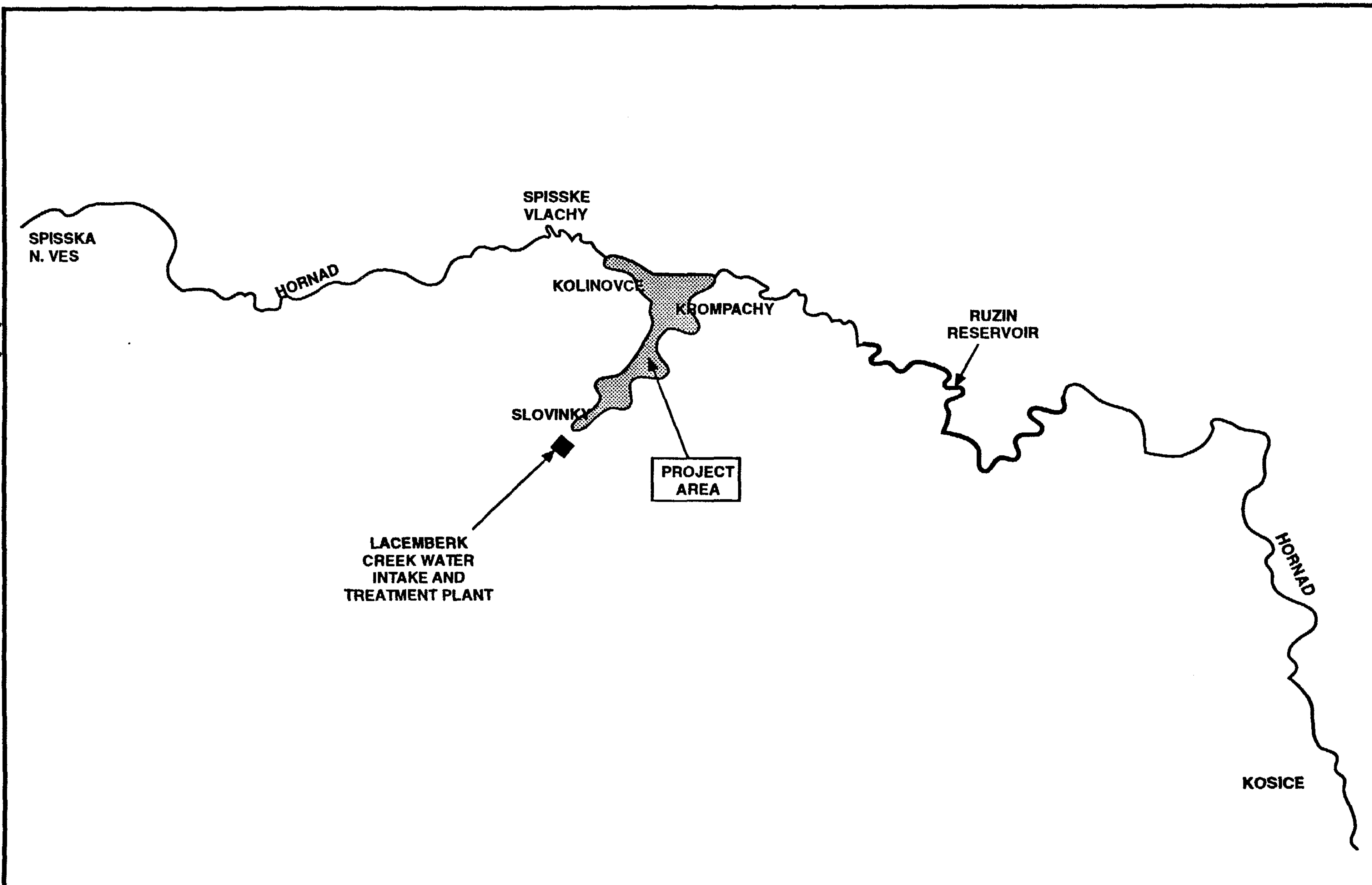


Figure 11
Map of Krompachy Project Area

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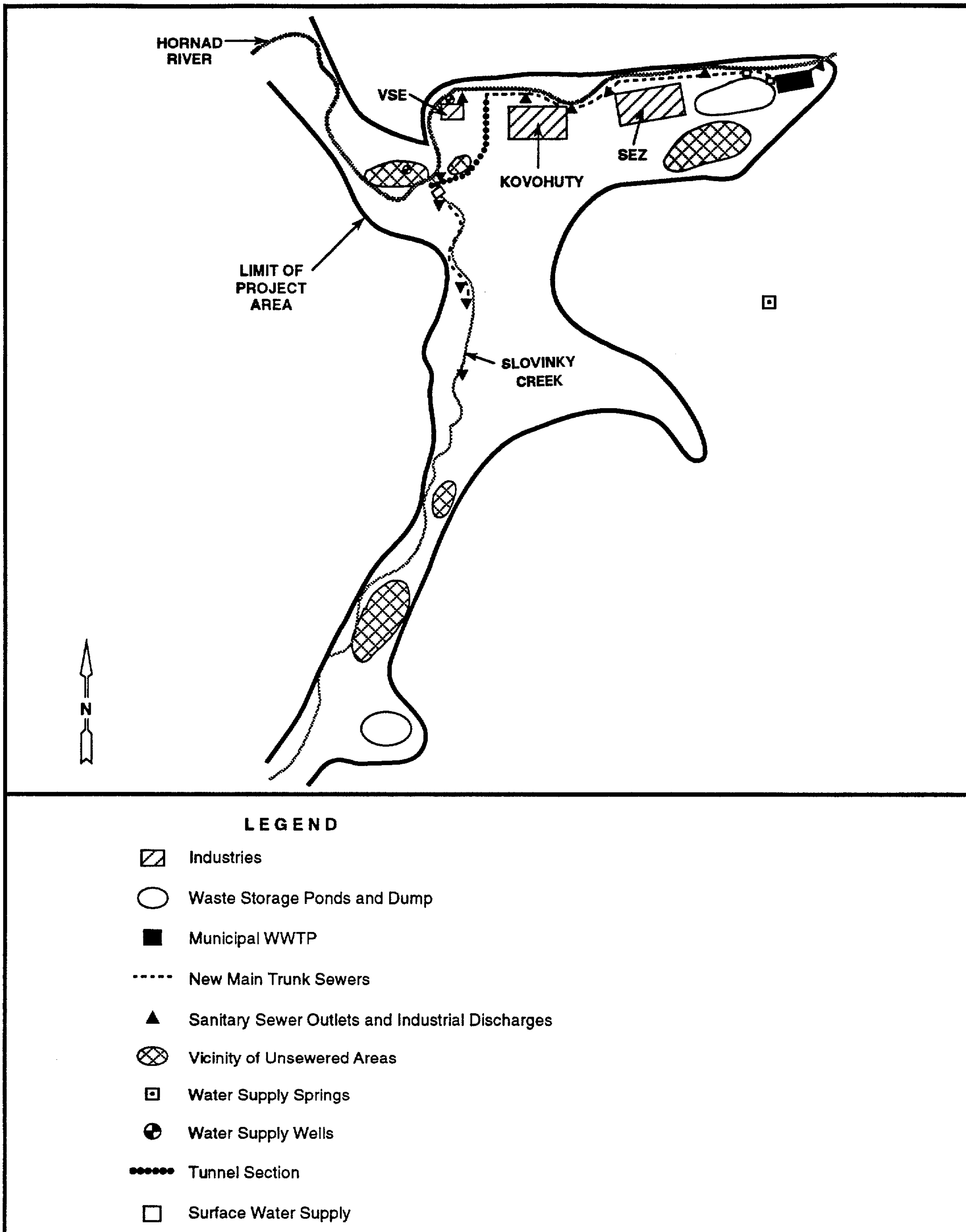

Figure 12
Krompachy Area Prefeasibility Study Site

The industries in the Krompachy area are few in number but their size and scope make Krompachy an important industrial center. The town's main industries consist of the Kovohuty copper smelter, Slovak Electrotechnical Enterprise (SEZ), and the VSE transformer plant. They are located in a large industrial zone lying in the floodplain of the Hornad. A solid-waste landfill and a partially completed municipal wastewater treatment plant are also located here (see Chapter 4). Mining and processing of copper ore was carried out until May 1993 in the nearby village of Slovinky.

Krompachy has been an industrial center for many years, even before the establishment of its modern-day industries. During the late 19th century, a steel mill was operating at the same location the current industries occupy, and mining and ore processing has gone on here for at least the last 400 years. The mineral ores in the central Hornad region are very complex, containing iron, copper, mercury, arsenic, zinc, and silver. Therefore, Krompachy's long history of mining and refining is accompanied by an equally long history of heavy-metal contamination in area soil and rivers. Thus, any program aimed at pollution abatement or remediation in the town must address this long-term, widespread contamination.

The most significant sources of water pollution in the proposed project area are as follows:

- the Kovohuty copper smelter, which discharges copper particulates, arsenic, and other contaminants into the air and water;
- the SEZ electrical components plant, which discharges metal-bearing wastewater from its galvanizing and electroplating operations;
- the municipal waste dump and lagoon along the Hornad River, which contain uncontrolled waste from industries, Krompachy, and six villages;
- the discharge of untreated municipal wastewater from residences and institutions throughout the city into ditches and the river; and
- ore processing facilities and a tailings pond at Slovinky.

Krompachy (population 8,241) has an existing sewerage network serving an estimated 98 percent of the town's residents and main commercial areas. The sewerage system currently discharges untreated effluent directly into the Hornad. A municipal WWTP, located 3.1 km from the existing sewerage network end, has been under construction since 1990. A trunk sewer is also under construction to connect the WWTP to the network. Work on both the WWTP and trunk sewer is proceeding in irregular stages because the central government is appropriating construction funds slowly and in small amounts.

VVAK plans to complete the new municipal WWTP and the new main trunk sewer for Krompachy. In addition, reconstruction and extension of the Krompachy sewerage network has been proposed, as have extension of sewer service to Slovinky and Kolinovce. However, financing for this work is extremely limited.

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In recognition of the above factors, a proposed project area is defined that encompasses the city of Krompachy and the villages of Slovinky and Kolinovce, and that includes all of the significant sources of pollution identified above. The grouping of projects at Krompachy combines projects 3, 4, and 7 from the list in Table 16 in Chapter 4 (the copper smelter, the municipal waste dump, and the WWTP).

As mentioned previously, the influence of the air and water discharges of contaminants in Krompachy reaches areas downstream and downwind of the proposed project area. However, the remedial work contemplated in the proposed project will be limited to the delineated area.

Of the significant environmental pollution sources indicated above, the one that stands out above all others is the atmospheric pollution contributed by the Kovohuty copper smelter. Its atmospheric copper concentrations are the highest in Slovakia, and its sulfur dioxide emissions consistently exceed acceptable limits. (See Appendix A and Table 17 for a description of the heavy-metal discharges from the Kovohuty plant.) The smelter pays fines for the reforestation of areas adversely affected by its air pollution.

5.2 Project Components

The proposed project provides a comprehensive effort to address the critical industrial and municipal wastewater pollution problems within the Krompachy area. The proposed project is broken into three phases based on priority ranking. These rankings are based on the severity of the problem being corrected, the availability of technical solutions to the problem, and the availability of funding to undertake the work. Given the scarcity of financial resources for all types of infrastructure and environmental investments now in Slovakia, it is likely that the project components will be implemented separately. Table 18 provides a breakdown of each project component's cost.

5.2.1 Phase 1: Highest Priority

The highest-priority components of the project target two industrial emissions sites. The first component addresses the biggest single pollution problem within the target area: the emission of large amounts of heavy metals in the air exhausts of the Kovohuty copper smelter. The second project component in this phase addresses wastewater treatment at the SEZ works. This component is already under construction.

Component 1.1: Institute air emissions control for the Kovohuty copper smelter.

Krompachy is one of the most polluted areas in Slovakia in terms of ambient air quality. Indeed, monitoring results from 1985-90 show that Krompachy had the country's highest in-air concentrations of heavy metals during that period. These concentrations often were significantly greater than those in the next highest polluted area in the country. The metals

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Table 17

Comparison of Kovohuty Air Emissions
versus Major Wastewater Discharges (Metric Tons per Year)

Parameter	Hornad River Downstream from Krompachy	SEZ Water Emissions	Kovohuty Water Emissions	Kovohuty Air Emissions
Arsenic 1991	27.90			63.36
Arsenic 1992	40.10			63.70
Copper 1991	7.64	2.68	0.70	55.83
Copper 1992	11.14	0.02	1.74	38.41
Zinc 1991	16.73	1.40		132.70
Zinc 1992	16.75	0.05		40.67

monitored in Slovakia from 1985-90 were zinc, cadmium, lead, copper, manganese, nickel, vanadium, and chrome, the first four of which were found in high concentrations in Krompachy (see Table A-5 in Appendix A).

Within Krompachy, the Kovohuty copper smelter is the singular source of heavy-metals emissions into the air. The plant's heavy-metal air emissions in metric tons per year are one to two times greater than either its or the SEZ plant's wastewater discharges into the Hornad. A comparative summary of Kovohuty air emissions versus Kovohuty and SEZ water emissions and levels carried in the Hornad in 1991 and 1992 is given in Table 17. The parameters in Table 17, copper, zinc, and arsenic, were the only ones monitored both for Kovohuty and the Hornad during the period cited. The comparison of emissions on a tons-per-year basis shows that monitored wastewater emissions from the two plants contribute only a fraction of the pollutant levels in the Hornad downstream of Krompachy. Conversely, air emissions from Kovohuty are at very high levels. Because these air pollutants have settled on the soils of the area for many years, they can be carried to the Hornad via surface runoff. Therefore, Kovohuty's air emissions are one of the likely sources of high metals concentrations measured in downstream waters.

It should be noted that the data in Table 17 contain gaps. For example, metals have not been monitored in the Hornad upstream of Krompachy, and upstream water polluting sources cannot be ruled out. However, the relative significance of air emissions from Kovohuty is apparent.

Regardless of their indirect impact on downstream water quality, controlling the Kovohuty smelter's air emissions takes the highest priority because of their effect on ambient air quality and, therefore, the potential long-term health of the area's residents. During discussions with the WASH team, Krompachy officials claimed very high incidences of respiratory diseases, particularly in children.

Kovohuty pays penalties for exceeding emission limits. The penalties in crowns for 1989, 1990, and 1991 were as follows:

	1989	1990	1991
Water emissions	89,285 Kcs	147,180 Kcs	123,603 Kcs
Air emissions	51,758	505,205	3,128,800

(Regulations changes in 1991 resulted in the significant increase shown in air emissions penalties.)

Kovohuty also paid penalties for assessed damages to farms and state forests as follows (in crowns):

	1989	1990	1991
Farm and forest damage	4,427,654 Kcs	5,018,674 Kcs	7,450,000 Kcs

Additional fees totaling 400,000 Kcs for damages to bee farmers were paid in 1990.

The Kovohuty smelter is in its second stage of privatization, and control of its air emissions as well as other environmental problems are closely tied to its restructuring. The enterprise has studied various options to control its emissions, and has made a number of investments to curb pollution, including installing particulate filters in 1988 and 1992. To complete the smelter's improvements, the most cost-effective approach would be to adopt new technology that would increase production efficiency while reducing emissions.

The main procedure targeted for improvement at the Kovohuty smelter is the enterprise's ore smelting process. In this process, imported and domestic copper concentrations are smelted using natural gas and hot air. Changing this process by installing an oxygen furnace (produced in Russia) was considered at one time, but the enterprise is now in contact with potential joint-venture partners (including those from the United States) to assist in overall technological changes instead. The cost of changing the technology used in this process has been estimated at 180 million Kcs, based on available Russian technology. Actual costs may be higher depending on the source and type of the technology being considered today, however.

Kovohuty officials have also studied improvements to its other manufacturing processes, as well as to its emissions control instrumentation, its wastewater treatment, and its metal

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sludge handling procedures. The cost of these other improvements is estimated to be approximately 20 million Kcs.

The WASH team was unable to obtain precise estimates of the costs of technology changes and air pollution control instrumentation from the Kovohuty copper smelter, primarily because the enterprise has not completed plans for its manufacturing process or business procedures. Nevertheless, an estimate of 200 million Kcs (about $US 7 million) is used here to compare the magnitude of this project component's cost with the cost of the other components detailed in this chapter. Process level studies at Kovohuty eventually should result in better definition of the smelter's needs and costs.

Table 18

Project Components and Their Cost

Phase 1	$US
Institute air emissions control for Kovohuty copper smelter	7,000,000
Complete the SEZ industrial wastewater treatment plant	No cost
Phase 2	
Relocate the municipal landfill	790,000
Design and reconstruct sewers in Krompachy	2,330,000
Redesign the Krompachy municipal sewerage and wastewater treatment plant and trunk sewer	4,260,000
Improve wastewater sludge disposal from SEZ and the Kovohuty smelter	Unavailable
Improve the operating efficiencies of the water supply and wastewater agencies	200,000
Phase 3	
Monitor the groundwater impacts of the mine tailings lagoon at Slovinky	No cost

Component 1.2: Complete SEZ industrial wastewater treatment facility improvements.

SEZ is a manufacturer of electrical components, including circuit breakers, switches, and various high- and low-voltage products. The enterprise was established in 1948 and recently was reorganized into nine smaller companies with a total employment of 1,825. SEZ is responsible for water and wastewater management for its companies, all of which share the same site.

SEZ's surface water (from the Hornad) is provided through Kovohuty facilities. The manufacturer's annual water use totals about 160,000 m^3 (both domestic and surface water), with wastewater emissions amounting to approximately the same volume.

The major source of pollution at SEZ is the enterprise's metal finishing operations, which include galvanizing and electroplating. Air emissions are primarily related to combustion of heating oil. SEZ has an industrial wastewater treatment plant that includes cyanide destruction, hexavalent chrome reduction, and chemical precipitation; however, its treatment facilities and operation are below acceptable standards. A detailed analysis of wastewater discharge from the SEZ plant is presented in Appendix A.

Monitoring results (see Appendix A) show that the concentration of metals from SEZ wastewater emissions greatly exceeded the permit limits in 1991. The 1992 emission levels met or were close to the emission limits. It should be noted that these limits are quite stringent for conventional treatment processes.

The SEZ complex has new plating and metals wastewater treatment facilities under construction. The new treatment facility is of advanced design with various recovery and recycling features and should provide high-quality effluent. Plans are to complete the new plant within the current calendar year; SEZ management reports that funds have been allocated to complete the facility.

On the basis of SEZ's commitment of funds for completing the wastewater treatment plant facility, the WASH team has indicated no cost for carrying out this component of the proposed project.

5.2.2 Phase 2: High Priority

Components in this phase address mainly municipal wastewater and solid-waste needs.

The following activities should be undertaken as soon as financing arrangements can be secured. Some of the technical assistance activities (redesign of the Krompachy municipal WWTP and main trunk sewer now under construction, the plan for improving the solid-waste dump site, and assistance in agency operating efficiency) should be considered high-priority candidates for donor grant funds now being programmed.

Special attention has been given to the capacity and design standards of the municipal wastewater treatment plant and trunk sewer. The WASH team recommended complete redesign of both facilities in order to reduce the plant capacity by half (in line with realistic demand projections) and replace the currently proposed trunk sewer tunnel with a lower-cost alternative. However, construction of both the plant and trunk sewer have advanced to points where potential capital costs savings are reduced. Local officials are reluctant to stop construction and change the design even though available funds are inadequate. Given the current state of their construction, merely modifying the systems to lower their operating costs would not make them more affordable either.

It should be noted that, even with some reductions in the costs of the municipal wastewater treatment plant and trunk sewer, the total project costs are still extremely high in terms of cost per household served.

Component 2.1: Relocate the municipal solid-waste landfill.

A description of the landfill and lagoon in the Krompachy area is presented in Appendix B. From this description and from field inspections, it is clear that these waste sites, particularly the municipal landfill lying in the Hornad floodplain, pose major pollution problems.

The Krompachy municipal landfill is located on the same site as the metal sludge lagoons, which receive wastes from the Kovohuty copper smelter and SEZ electrical components plant. It is also located immediately adjacent to the Hornad River and therefore is a potentially significant source of contaminated surface runoff, as well as subsurface leachate.[4]

Municipal solid waste is now collected regionally and deposited in the Krompachy landfill and in landfills in Spisske Vlachy. Six villages now dump their waste in the Krompachy landfill under a contract with Krompachy Municipality. Annual operating costs for the Krompachy landfill are reported to be about 1.1 million Kcs.

Negotiations are now under way between Krompachy and Spisske Vlachy for Krompachy to participate in a new regional landfill to be located at an abandoned clay mine in Spisske Vlachy that is reportedly able to meet disposal requirements for the next 50 years. The Krompachy Municipal Council has recommended joining the regional landfill and closing the existing landfill in Krompachy.

It is anticipated that as part of the new regional disposal operation, solid waste would be separated by the individual communities. In Spisska Nova Ves, an Austrian firm is reported to be operating a materials recovery facility. The Krompachy municipal government has expressed interest in using this technology also.

Estimated costs for this component are $US 70,000 for the plan and feasibility study, and $US 720,000 for the regional landfill and equipment cost (Krompachy's share).

[4] A detailed survey of the landfill site is being undertaken by the District Geological Survey Office in Spisska Nova Ves with results available in mid-1993.

Component 2.2: Design and construct sewer extensions in Krompachy (including hospital and industrial sanitary wastewater connections).

As part of the design work performed by Hidrocounsult on the Krompachy main trunk sewer and WWTP, a visual inspection of the existing Krompachy sewerage network was made at accessible points in 1988. Photography and video inspection were not performed to determine the physical condition of the system, however, and some sewers are known to be more than 50 years old.

As a result of the inspection, the following conclusions were drawn:

- Existing sewers
  - in satisfactory condition 3,766 m
  - needing reconstruction 4,935 m
- Sewer extensions needed 8,393 m

The existing sewerage network is a combined system that collects both sanitary sewage and storm water. As a result, pipe sizes are much larger than would be required for sanitary sewage (from residences and institutions) alone.

The design of the Krompachy municipal WWTP includes allowances for sanitary wastewater from the two neighboring villages of Slovinky and Kolinovce. Connecting Slovinky with the Krompachy system would require a connecting main about 3 km in length; connecting Kolinovce would necessitate a connecting main about 0.8 km long. Neither village has a municipal sewer system, but Slovinky is supplied with public water.

About 98 percent of Krompachy's population is connected to the existing sewerage network through 347 connections; however, 442 additional connections are required to supply the town's estimated 789 buildings (houses, flatblocks, and institutions) adequately (one connection per house). (It is reported that all flatblocks are now connected.) In addition, the hospital WWTP is to be abandoned and connection made with the municipal sewer system.

For Slovinky, an estimated 570 household connections would be required if the village were to connect with Krompachy's WWTP. For Kolinovce, about 130 connections would be required.

The costs for connecting Slovinky and Kolinovce to the Krompachy WWTP are quite high in terms of cost per household served. In both cases, new sewer networks would have to be constructed in addition to trunk sewers linking those towns to the main Krompachy network. In sum, sewering both towns would cost about $US 2,650 per household (Slovinky) and $US 2,700 (Kolinovce) before adding in costs for household connections and any allocation for the main WWTP and trunk sewer costs (see Component 2.3

below). Given these very high costs, the WASH team has dropped further consideration of sewering Slovinky and Kolinovce from the proposed project.[5]

The estimated cost for sewer reconstruction and extension in Krompachy is $US 2.33 million.

Component 2.3: Complete the redesign of the Krompachy municipal wastewater treatment plant and trunk sewer.

<u>Wastewater Treatment Plant</u>

The Krompachy municipal WWTP is now about 75 percent complete, with most of the remaining work to involve equipment purchases and installation, site work, landscaping, and contractor demobilization.

The WWTP is designed for a 2020 population equivalent of 21,926, an average of 255 L per capita per day. It is intended to receive wet weather flows of up to 429 L per second (L/s), or about seven times the dry weather flow. However, flows above 129.2 L/s will enter storm water storage tanks to capture the assumed "first flush" of pollutants. Excess flows are to be bypassed directly to the river.

Once completed, the Krompachy WWTP will be essentially an extended aeration plant without primary settling tanks. It is designed to remove more than 90 percent of BOD_5 and suspended solids (SS), but it is not designed to remove inorganics and heavy metals. At average design flow, the detention time in the aeration basins is about 17.4 hours. At maximum flow, the detention time is about 8.7 hours. It appears therefore that the design is quite conservative in that the aeration will have estimated detention times of 24 to 29 hours for projected 2020 average flows. Furthermore, the design and construction of a mechanical (primary settling) treatment plant for Krompachy would have been sufficient to protect the Hornad River in light of other water pollution sources in the area.

No site for disposal of the sludge produced by the WWTP has been finally determined. If the heavy-metals content is within acceptable limits, local farms may be willing to accept the sludge. However, WWTP designers did not determine influent flow characteristics or content (by flow gauging and sampling). Because the sewerage network is combined and storm water runoff carries slag containing heavy metals, the quality of the sludge may be unacceptable for land application even if pretreated industrial wastewater is not received at the WWTP. It appears that because of this uncertainty, a large thickened sludge storage tank has been provided, but this tank does not provide a long-term answer for sludge disposal or use at Krompachy.

It is estimated that the total cost to construct the WWTP to the existing design and using existing methods would be about $US 5.78 million at mid-1993 prices. Of this amount, about $US 1.31 million remains to be spent. The latter figure could be lowered somewhat

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[5] The problem of affordability in Slovinky is compounded by the fact that the Slovinky mine closed in May 1993, eliminating the main source of employment in the town.

by reducing the equipment specifications in line with reduced water treatment demand estimated by the WASH team (see below). However, the current design specifications make no provision for sludge handling—an ommission that will require higher operating costs and additional future capital investment. At this time, 80 to 85 percent of the structural work is complete, although little or no equipment installation has begun. The belt filter press has been purchased and is stored at the site.

The WASH team re-estimated the total demand requirements of the Krompachy WWTP and, as alluded to above, found that the current planned capacity (64.6 L/s or about 1.5 mg per day) is about twice the requirement that might reasonably be expected even under optimistic growth scenarios (See Appendix C). Local engineers, however, dispute this finding. The reasons for this reduced demand forecast (maximum capacity of 32 L/s) is the already observed reduction in Krompachy's industrial work force (down to about 60 percent of previous levels), coupled with a lack of alternative employment options.[6]

The total estimated construction cost of $US 5.78 million equals about $US 4.00 per gpd (gallon per day) of capacity. This cost is on a par with costs for advanced secondary WWTPs in the United States, despite a better than 5 to 1 difference in labor rates. It is concluded that the construction cost of the 64.6 L/s Krompachy WWTP is approximately twice what it should be using Western construction practices. The fact that the WWTP is already so far along limits the ability to reduce capital costs by downsizing the plant's capacity to 32 L/s, however. Nonetheless, opportunities exist to minimize operation and maintenance costs, including providing about half of the equipment originally intended, reducing the amount of storm flow reaching the WWTP, and reducing staff size consistent with operational needs.

Krompachy Main Trunk Sewer

The new main trunk sewer is estimated to be about 20 to 25 percent complete, based on observation of construction and discussion with its design engineer. The sewer has a total length of about 3.1 km and terminates at the new municipal WWTP. Approximately 700 m of this trunk sewer is designed as tunnel, with the remainder left for open cut construction.

The diameter of the trunk sewer varies from 800 mm to 1.4 m, and the pipe is heavy, walled unreinforced concrete without preformed gasket joints. For this project, extra-strength reinforced concrete pipe should be used because the sewer is laid close to the surface for much of its length, and the area has considerable truck traffic, especially at industrial sites. Pipe bedding and backfilling appear to be inadequate to provide proper pipe support under the observed conditions.

The trunk sewer size is based on a standard ratio of seven times the dry weather flow, to provide storm flow carrying capacity. However, it is clear that a lower ratio would be

[6] It should be noted that the reduced forecast does allow for substantial growth in wastewater demand from Krompachy and its main industries (i.e., the reduced forecast is quite conservative).

sufficient because more frequent overflows of mixed sewage and storm water would have minimal impact on either Slovinky Creek or the Hornad River. A ratio of three or four times the dry weather flow is commonly used. Thus, the size of the main trunk sewer is greater than it need be.

The trunk sewer tunnel portion involves the use of a 1.6 m diameter shield and a tunneling machine to bore into the fractured rock (schist). This method is extremely expensive. Exact progress of the tunnel construction was estimated to be about 20 to 25 percent complete as of April 1993. By May 1, 1993, the WASH team learned construction had been stopped for lack of funds in this fiscal year. The team suggested that because tunnel construction was not too far along, consideration should be given to stopping it and proceeding with a less expensive alternative. However, local officials said it is too late to change the design.

It is estimated that the construction cost of the tunnel section represents about 66 percent of the total cost of trunk sewer construction, which is estimated at about $US 3.93 million at mid-1993 cost levels. The WASH team estimates that about $US 2.95 million would be required to complete the trunk sewer under the current design specifications. That figure could be lowered to about $US 2.5 million with some modifications in the design. The unit cost of the tunnel construction is about $US 1,130 per lineal foot (l.f.), compared with less than $US 170 per l.f. for the open cut construction. Thus, combining $US 2.95 million remaining to be spent on the trunk sewer and $US 1.31 million remaining to be spent on the WWTP produces $US 4.26 million, the total cost for Component 2.3, as noted in Table 18.

Component Costs

Originally, VVAK estimated that the WWTP and trunk sewer would cost 137 million Kcs in 1988. Of that amount, about 60 million Kcs has been spent, but high inflation has now pushed estimates to a final budget of about 250 million Kcs (in 1993 figures). This means that current estimates from VVAK now total about 150 million to 160 million Kcs to complete the project as originally designed, as the agency has already spent $US 90 million to $US 100 million on it. About 20 million Kcs is expected to come from the VVAK in 1993, and local funds are unavailable. At this rate of expenditure the project will never be completed, since construction cost escalation is running at about 25 percent annually.

The WASH team has examined several alternative configurations to determine if the facilities could be redesigned in "mid-stream" to lower their cost significantly. Unfortunately, the state of completion makes it difficult to alter the design without abandoning the work already done. For example, the WWTP might be reconfigured to accept the much reduced flow, lowering some of the equipment costs and certainly a large part of the operating costs. Unfortunately, however, the plant cannot be readily reconfigured as a primary treatment facility. The trunk sewer remains the larger of the remaining component costs and requires expensive tunneling as now designed. However, at the current state of completion, it is unclear that any alternative can substantially lower the component's final cost.

One overriding cost problem that should be addressed immediately is the very high construction cost, despite low labor rates prevailing in Slovakia. As noted above, the WASH team estimates that construction costs may be up to twice as high as they should be, based on simple comparisons with cost factors in the U.S. (this issue is the target of Component 2.5 below).

Component 2.4: Improve wastewater sludge disposal from SEZ and the Kovohuty smelter.

Both SEZ and the Kovohuty smelter store metallic sludges in lagoons at the Krompachy solid-waste landfill. The Kovohuty lagoon is by far the most extensive. It was established before the present water law was enacted in 1974 and so does not comply with existing regulations. The area of the lagoon is reported to be 23,300 m^2. According to the analyses available from Kovohuty, no contamination of groundwater has been observed. Appendix B provides a more detailed description of the lagoon's characteristics and contents.

The exact area of the lagoon is difficult to determine due to the municipal wastes that are being deposited almost in the same area. Consequently, the WASH team could not obtain a map showing the exact situation and the dimension of the lagoon. Slovakia's District Geological Survey is carrying out monitoring of the lagoon but could not provide results until mid-1993.

The Kovohuty lagoon contains, in different sections, manganese waste, manganese sludges, and copper neutralization sludges.

Currently, the copper sludges are reprocessed in Kovohuty due to their high copper and nickel content. In the future, all of them should be processed and removed from the lagoon. The byproduct of the processing will be calcium sulfate by number of water molecules ($CaSO_4$ x nH_20). In one part of the lagoon that is separated from the others, hazardous wastes are deposited that originate from zinc sulfate production.

The production of the sludge is approximately 150 to 180 tons per year. The amount deposited in the lagoon is estimated to be 3 kilotons of dry matter.

The Krompachy municipal landfill also contains concrete tanks for the sludge resulting from SEZ's neutralization station. The older tank is full (volume 900 m^3) and the new one is filled up to one-third (volume 1,200 m^3). The transport frequency is two times a month. In 1991, the volume transported was 425 m^3, and in the first half of 1992, 230 m^3. Information on its chemical composition is unavailable. The sludge from the new neutralization station of SEZ (to be put in operation this year) will be taken away and subsequently processed by that station's supplier.

Once the municipal solid-waste landfill has been relocated to Spisske Vlachy, the sludge lagoons of Kovohuty and SEZ should be revamped. When the Slovakian Geological

Survey's study on the site is released in 1993, it should be clear what additional studies will be needed to design the lagoon's improvement program. Until that time, no cost estimates are possible on the size and scope of the effort.

Component 2.5: Improve the operating efficiencies of the water supply and wastewater agencies.

At present, all local water and sewer services in Krompachy are provided through VVAK. As noted above, design standards (including demand forecasts) and construction costs are quite high, raising the capital costs of facilities to great, and now unaffordable, heights. Part of the problem simply involves changed assumptions about demand. With Slovakia's economic transformation taking place, employment and population will shift from previous patterns. Water consumption and wastewater production will change as a result of higher tariffs and changing consumption patterns by differing income groups. All of these considerations completely alter the demand assumptions on which facilities planning thus far has been based.

Construction costs also appear to be quite high, as noted earlier. In this prefeasibility study, the WASH team was unable to ascertain the reasons for these high costs, but it is clear that they must be brought down considerably in order to make the facilities affordable.

Another cost problem that must be addressed by this project component is the high operating costs of water and sewer services. VVAK has historically had the highest operating costs of all the regional water works authorities in the country, due to the long distances over which water must be moved. However, VVAK's operating costs have risen about 100 percent over the past three years, slightly higher than the rate of inflation. As wage rates escalated, there seems to have been no gain in productivity as seen in the industrial or private sector. Currently, VVAK receives operating subsidies from the central government, so its "true" cost of water/sewer services is approximately 13 Kcs $US 0.45) per cubic meter.[7]

This component involves technical assistance activities to the VVAK in two areas: financial management and cost controls in operating expenditures, and cost-effective facility design and capital financing strategies.

The estimated cost of this component is $US 200,000.

[7] This cost does not reflect the actual cost of capital facilities since depreciation recovery is quite low and the asset base on which depreciation is figured is artificially low.

5.2.3 Phase 3: Lower Priority

Component 3.1: Monitor the groundwater impacts of the mine tailings lagoon at Slovinky.

The mine tailings lagoon at Slovinky is extensive in area although no data are available on its exact volume or dimensions. Given the nature of the ores mined at Slovinky, the lagoon holds various heavy metals, including mercury, arsenic, zinc, and copper.

The shutdown of the Slovinky mine in May 1993 will stop the growth of the lagoon but create a potential problem as the operation is abandoned. Currently, there is a periodic monitoring program for impact on groundwater in the vicinity of the lagoon. This component ensures that this monitoring will be continued.

The mine was run by the Zelezorudne Bane Works mining enterprise, which now may undergo privatization. Of concern is who will be responsible for cleaning up past pollution, including liability for the mine tailings lagoon.

The WASH team has estimated no cost for this component, given that the aforementioned monitoring program is ongoing. However, steps should be taken to develop a strategy for dealing with the mine tailings lagoon in light of the closing of the Slovinky mine.

5.3 Implementing the Project

The project components are divided between industrial sites and municipal sites. The highest-priority component, reducing heavy metals in Kovohuty air emissions, will depend largely on introduction of new technology to the production processes, as well as switching to higher-grade ore. This new investment, in turn, depends on the long-term commercial viability of the copper smelter, which may likely involve participation of outside joint venture partners. One of the issues that must be dealt with before any such joint ventures occur is the limitation of liability for hazardous waste cleanup. At present, the extent of hazardous waste accumulation in the area that is traceable to the copper smelter is unclear, as is the extent of legal liability for cleanup that will be assigned to the smelter after privatization.

The municipal government currently has a mandate to manage the solid-waste facilities, and it may acquire additional responsibilities under proposed reform of the water supply and sewerage sector. Since the shape of reform in the sector is not yet clear, implementation responsibility for the municipal WWTP and sewerage network will remain with the regional water works authorities. Furthermore, tax reform for the municipalities has not yet been completed; therefore, the municipal governments are operating with greatly reduced revenues. It will remain uncertain whether they will have adequate resources to finance infrastructure investments until after the municipal tax reforms are put in place in late 1994.

5.4 Financing the Program

5.4.1 Industrial Sites

Preliminary discussions with the management of the Kovohuty smelter indicate that the enterprise is profitable and that the level of investment needed to correct its air emissions problem should be within the means of the company. Current annual sales of the smelter are approximately $US 63 million, with an operating profit of about $US 7 million. The cost of the investment is also about $US 7 million (see Component 1.1), which places it within a "financeable" range. The potential return is enhanced by the fact that the smelter is currently paying about $US 1.0 million in fines, which could be avoided by making the investment. In addition, production technology changes, as part of the investment package, should also make the enterprise more competitive. For all these reasons, the investment package appears to be affordable.

The main obstacle to the investment now is that Kovohuty's management is awaiting the outcome of the privatization process before undertaking any new such expenditures, especially those involving technology changes. In turn, the privatization process is being held up by the uncertainty of liability for past environmental contamination that will be passed on to the new owners of the smelter. Since the Kovohuty site (including sludge lagoons) is certainly contaminated with heavy metals, and the smelter operations have contributed to the heavy-metal sediments in the Hornad, potential liability for the smelter owner could be enormous. Therefore, the issue of liability must be resolved definitively before the private sector will invest in the smelter.

The new wastewater treatment facility at the SEZ industrial site has funds earmarked for its completion; SEZ management foresees no problem in completing the facility.

5.4.2 Municipal Sites

The municipal components of the proposed project raise much more difficult problems of affordability. Table 19 shows the per household costs of Components 2.1 through 2.3 (relocation of the municipal landfill, sewer reconstruction in Krompachy, and completion of the WWTP and trunk sewer).

The relocation of the municipal landfill will require a modest investment by the municipal government, a portion of which should be recoverable through user fees. The cost of the investment is approximately 20 million Kcs, which would require an annual debt service of 3.73 million Kcs, assuming a 15-year loan at 16 percent interest (the current controlled rate). This may be compared with existing operating costs of the Krompachy landfill of 1.1 million Kcs, and the total municipal operating budget (1993) of about 17 million Kcs. In sum, the amortization payments for the landfill relocation would amount to 22 percent of the municipal budget in 1993, or roughly 3.5 times the operating cost of the existing landfill operation.

The capital cost (construction and equipment) of the landfill relocation comes to about 8,240 Kcs per household ($US 292) which, if financed on the same terms, would produce a monthly payment of 121 Kcs. This amounts to about 1.2 percent of monthly household income for Krompachy residents. This is slightly less than what households will be paying for water and sewer services in Krompachy in 1993.

The above figures suggest that the landfill project will strain the municipality's budget or, alternatively, place a sizable (but not unaffordable) burden on households if financed directly by user charges. Although the mayor of Krompachy has expressed willingness to borrow funds for the landfill project, it is not assured that the municipal council would agree to the project on these cost recovery terms. However, the municipality has no investment funds at present and would require either a grant or loan to undertake the project. Currently, the only source of such funding would be a grant from the Environmental Protection Fund,[8] barring some sort of special appropriation from the state budget. Preliminary discussions are also under way to establish some form of municipal lending program, but that would take several years to establish and capitalize. In the meantime, the central government may want to consider establishing a "transitional" infrastructure financing scheme that can at least keep some funds flowing to high-priority projects.

The financing of the Krompachy municipal WWTP and main trunk sewer raises a set of special problems. First, the cost of the project is quite high in terms of cost per household served. The cost to complete only the WWTP and trunk sewer totals approximately $US 1,700 per household. This is in addition to the amount already invested in the construction (about $US 1,300 per household) and the amount required to reconstruct portions of the Krompachy sewerage network (Component 2.2) in need of rehabilitation (about $US 950 per household). In assessing affordability, one may compare this with an estimated annual average income per household in Krompachy of about $US 3,950. Amortizing the total cost of these investments over 15 years at the current (controlled) interest rate of 16 percent would require an amount equal to about $US 708 per year per household, or about 18 percent of total household income.

[8] Under current legislation, the Environmental Protection Fund can only make grants, although there are now proposals to enable it to make loans as well.

Table 19

Per Household Costs of Capital Construction Components (in $US)

Component	Total Cost	Total Cost/Household	Monthly Payment
2.1 Landfill relocation	790,000	292	5.12
2.2 Sewer reconstruction	2,330,000	946	13.89
2.3 WWTP and trunk sewer completion	4,260,000	1,700	29.40

VVAK has budgeted a small amount to keep the construction of the Krompachy project going, but that amount is less than that needed to match inflation on the remainder of the investment. VVAK itself might be expected to provide some funds toward capital investment with the increased revenue generated by recent large tariff increases. However, VVAK is projecting very large increases in its own operating expenses to the point that it predicts continued losses, requiring further state subsidy.

VVAK's operating cost increases are worrisome because the aforementioned water/sewer tariff is the best candidate for capital cost recovery available in the near term. If VVAK's operating costs continue to rise faster than inflation and consume all increased revenue from tariff hikes, capital cost recovery through the tariff will be impossible.

In summary, the mechanisms for generating cost recovery for major water and sewer investments are quite limited at present in eastern Slovakia. Municipal general revenues are insufficient and will not increase until some time after the local tax reform takes effect. The other potential source of cost recovery is via the water/sewer tariff. The tariff has room for further increase[9], but VVAK's operating expenses, as noted above, must be much better controlled if a tariff increase is to be feasible. The WASH team has recommended a component in the proposed project to provide just this type of managerial assistance (Component 2.5).

[9] As the residential tariff is raised, consideration can be given to some form of progressive rate structure so that a minimum amount per month can be provided to each household at a relatively low price.

5.5 Next Steps

5.5.1 Industrial Sites

Two critical issues must be resolved on the industrial side, both of which require action at the national policy level: determination of legal liability for cleanup of past contamination for industries undergoing privatization; and availability of medium-term credit for moderately sized environmental investments ($US 1 million to 15 million) that are too small to qualify for funding by major international lenders as a single loan project. Until these two issues are resolved, investments in industrial sites will continue to move slowly.

5.5.2 Municipal Sites

Three main institutional issues require immediate attention: 1) resolution of the proposals for restructuring the delivery of water supply and sewerage services at the local level so that the appropriate financing and management support systems can be put in place; 2) introduction of measures to control both operating costs and capital costs of new facilities of the water works authorities; and 3) creation of a capital financing structure that can channel both grants and loans to worthwhile projects at the local level. Resolution of the first issue will largely determine how the other two will best be handled.

In terms of the recommended projects in the Krompachy area, the only municipal investment component that appears feasible at this time is the landfill relocation. The next steps for this component include development of detailed costs, selection of a cost recovery strategy, and identification of financing sources. Immediately, this means making application to the Environmental Protection Fund for a grant for all or part of the capital cost. If partial grant financing is available, then a cost recovery strategy will be required, probably relying on direct user charges.

5.5.3 General

It has become clear during the course of WASH's pre-investment studies that an overall strategy for the Hornad basin watershed is required that goes beyond the scope of the current, short-term study. While there are clearly some actions that should be taken immediately (e.g., cleanup of the air emissions at the Kovohuty smelter), the widespread heavy-metal contamination in the upper and middle parts of the basin raises questions about how effective individual pollution abatement projects can be.

An overall strategy would provide a framework in which investment decisions and pollution control interventions could be made. For example, the strategy would enable decision-makers to decide whether limited funds should be spent to build new municipal WWTPs, implement industrial waste pollution control measures, clean up solid- and hazardous-waste dumps, or integrate a number of such efforts into comprehensive programs.

The government of Slovakia has the institutional structure, through the river basin authorities, to carry out such a strategy. Although sizable data gaps still remain (especially regarding the extent of heavy-metal pollution and toxic organic compounds), significant database and analytical capabilities are available within the country to begin such work. The current pre-investment studies under the Danube Environmental Program have laid the groundwork for developing such watershed strategies in the basins studied. In addition, international donors could play a very useful role in supplying expertise in the areas of industrial waste treatment technologies, waste minimization, economic and financial analysis, and technical assistance in some of the watershed modeling methods.

Appendix A

INDUSTRIAL WASTE SOURCES

General

The industries in the Krompachy area are few in number but their size and scope make Krompachy an important industrial center. The industries consist of the Kovohuty Copper Smelter, Slovak Electrical Works (SEZ) and the VSE Transformer Plant. They are located in a large industrial zone (complex). A solid waste landfill and a partially completed municipal wastewater treatment plant are also located here. Mining and processing of copper ore was done until recently in the nearby village of Slovinky. The Slovinky Creek runs through Krompachy.

Krompachy has been an industrial center for many years even before the establishment of the present industries. For example, a steel mill was operating at the same location of the present industries in late 19th century. The area was the largest center of mining and metal processing in Upper Hungary as it was called then. Krompachy has a history of about 700 years and mining and metal processing have always been central to its existence as mentioned in all of its historical documents. Mining for mercury and other metals in the Hornad Basin upstream of Krompachy has also been done for centuries. Industrial solid waste/hazardous waste problems in the area are clearly significant and are inextricably tied to the recent as well as distant past industrial activities. Diagnosis of environmental problems and formulating priorities require recognition of this factor. For example, sediments contaminated with heavy metals to several meter have accumulated in the Hornad riverbed and mine tailings have been accumulated in an immense dam in Slovinky for many years. Air emissions over many years have been deposited on the environment.

Industries

A brief description of the industries in Krompachy and summaries of available data are given below. The mining operations in Slovinky are also described.

The Kovohuty Works (Copper Smelter)

This state enterprise was built on this site in 1951. It processes copper and manganese ore and produces copper and manganese. Sulfuric acid and zinc sulfate are also produced as by-products. The enterprise is in its "second stage of privatization". General data on the enterprise are given in Table A-1. Water use and air emissions data are given in Table A-2.

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Table A-1

General Data

Annual Sales (1992)	US$ 63,000,000
Annual Production in metric tons (1991)	
Copper	25,273
Manganese	416
Sulfuric Acid	37,900
Zinc Sulfate	915
Employees (1992)	1,172

Table A-2

Water Use and Air Emissions Data

Water Use and Emissions, 1991

Annual Potable Water Use (m^3)		116,665
Annual Industrial Water Intake from Hornad (m^3)		1,833,673
Total Water Use (m^3)		1,950,338
Annual Emissions to Hornad		
Volume (m^3)		1,735,000
BOD (mg/l), tons	(4.7)	8.2
COD (mg/l), tons	(4.5)	7.8
Cu (mg/l), tons	(0.4)	0.7
Ni (mg/l), tons	(0.5)	0.8

Air Emissions, 1992

Annual Emissions, tons	
Particulates	242.1
Copper	38.4
Zinc	40.7
Lead	21.4
Tin	4.6
Arsenic	63.4
Sulfur Dioxide	10,125
Carbon Monoxide	1,457

The Kovohuty Copper Works has an industrial wastewater treatment plant that provides chemical treatment for precipitation of metals and solids. The treatment system is very simple and has minimal instrumentation. Sedimentation and sludge removal is done in batches in large sumps. Sludge is transported to lagoons located in the landfill area. The monitoring data indicate acceptable effluent quality. The major issues related to the wastewater treatment plant are reliability, labor intensive operations and sludge handling.

Air emissions are significant and limits are exceeded by a large margin. The enterprise has studied various options for control of emissions. The most cost effective approach is considered to be installation of new technology that increase production efficiency and reduce emissions at the same time.

The Kovohuty Works estimate that more than 200 million Slovak Crowns ($US 7 million) would be needed to comply with all the current emission limits with most of the investment going to technology changes.

The Slovakian Electrical Works (SEZ)

SEZ is a manufacturer of electrical components including circuit breakers, switches and various high and low voltage products. The enterprise was established in 1948 and recently was reorganized into several smaller companies. These companies and their 1993 personnel levels are listed below.

SEZ Joint Stock Company	1,372
Foundry Joint Stock Company	121
Engineering Joint Stock Company	56
ABB STOTZ, Ltd.	56
Krompoft, Ltd.	21
Risep, Ltd.	47
Maintenance, Ltd.	84
Transportation, Ltd.	12
Service, Ltd.	56
Total	1,825

SEZ is responsible for water and wastewater management for all these companies which share the same site. Surface (Hornad) water is provided through Kovohuty facilities. The annual water use by the SEZ complex consist of 99,720 m^3 of domestic water plus 61,628 m^3 of surface water for a total intake of 161,348 m^3 based on 1991 figures. The water emission volume was estimated at 161,300 m^3 for the same period. The major source of pollution on this site is the metal finishing operations such as galvanizing and electroplating. Air emissions are primarily related to combustion of heating oil. The plant has an industrial wastewater treatment plant that include cyanide destruction, hexavalent chrome reduction and chemical precipitation. The treatment plant construction and operation is below acceptable standards.

The effluent monitoring data (for the combined industrial and domestic components) for 1991 and 1992 are given below in Table A-3.

Table A-3

Effluent Monitoring Data

	Limit	1991		1992	
Parameter	mg/l	mg/l	tons/year	mg/l	tons/year
BOD5		6.4	1.16	12.0	1.31
Iron	0.2	19.1	3.40	0.15	0.01
Copper	0.2	16.6	2.90	0.17	0.01
Zinc	0.2	8.7	1.30	0.39	0.03
Cadmium	0.2	1.0	0.17	0.002	
Nickel	0.05	0.2	0.03	0.02	
Chromium	0.04	0.17	0.03	0.005	
Silver	0.04	0.02	0.005	0.001	
Cyanide	0.5			0.25	0.02

The monitoring results show that concentration of metals greatly exceeded the permit limits in 1991. The 1992 emission levels meet or are close to the emission limits. It should be noted that these limits are quite stringent for conventional treatment processes. The SEZ complex has new plating and metals wastewater treatment facilities under construction. The new treatment facility is of advanced design with various recovery and recycle features. This facility should provide high quality effluent.

The Zelezorudne Bane Works (Slovinky)

These facilities are located in the Village of Slovinky and are not operational. They had been processing copper ores until recently. A mine tailings dam was built in 1968 to serve these operations. It is located on the Slovinky Creek which flows through Krompachy into the Hornad. The dam is 60 meters high and is a possible source of pollution.

Comparison of Pollution Loads and Impacts

Given the extent of past and present pollution in the area from a wide variety of sources, the impact of the pollution loads from the industries in the Krompachy area should be assessed relative to other factors. Table A-4 gives basic flow data and a comparative summary of pollution levels and emissions for the parameters of copper, zinc, and arsenic which has been monitored both in the Hornad and the industrial emissions. A further summary is given in Table A-5.

The above comparison shows that wastewater emissions from the industries contain only a fraction of the pollutant levels in the Hornad downstream of Krompachy. On the other hand, air emissions of pollutants from Kovohuty are at very high levels. As these air pollutants had been deposited on the soils of this area for many years, they would be carried to the Hornad through surface runoff. It is recognized that there are data gaps and also sampling and analysis methods may not reliable, however, the relative significance of air emissions are apparent. Significance of air emissions in Krompachy is also indicated by 1985-1990 ambient air quality data for Slovakia for heavy metals (see Table A-6).

Table A-4

Krompachy Area—Copper, Zinc, and Arsenic Emissions and Levels

DESCRIPTION	1991							1992						
	Volume	Copper		Zinc		Arsenic		Volume	Copper		Zinc		Arsenic	
	m^3/year	mg/L	t/y	mg/L	t/y	mg/L	t/y	m^3/year	mg/L	t/y	mg/L	t/y	mg/L	t/y
WATER USE														
Domestic	116,665							90,398						
Kovohuty	99,720							88,109						
SEZ														
Industrial Use	1,833,673							1,217,730						
Kovohuty	61,628							48,026						
SEZ														
Total Water Use	1,950,338							1,308,128						
Kovohuty	161,348							136,135						
SEZ														
WATER EMISSIONS	1,735,000	0.40	0.70					1,735,000	1.00	1.74				
Kovohuty	161,300	16.60	2.68	8.70	1.40			135,140	.17	0.02	0.39	0.05		
SEZ														
INDUSTRIAL SLUDGE	425							635						
Kovohuty														
SEZ - Metal Sludges (3% S)														
RECEIVING WATERS	0.49	0.02	0.30	0.02	0.30	0.07	1.02	0.49	0.03	0.46			0.13	1.96
Slovinky Creek	7.87	0.03	7.64	0.07	16.73	0.11	27.90	7.87	0.04	11.14	0.07	16.75	0.16	40.10
Hornad Downstream of Krompachy														
AIR EMISSIONS			55.83		132.70		63.36			38.41		40.67		63.70
Kovohuty Plant														

Table A-5

Copper, Zinc, and Arsenic Levels
(Tons per Year)

Parameter	Hornad River Downstream of Krompachy	SEZ Water Emissions	Kovohuty Water Emissions	Kovohuty Air Emissions
Copper 1991	7.64	2.68	0.70	55.83
Copper 1992	11.14	0.02	1.74	38.41
Zinc 1991	16.73	1.40		132.70
Zinc 1992	16.75	0.05		40.67
Arsenic 1991	27.90			63.36
Arsenic 1992	40.10			63.70

As shown in the above table Krompachy had the highest heavy metal concentrations in the air in Slovakia in 1985-90 and often significantly higher than the next highest polluted area.

Solid Waste Sites

Krompachy area has a large number of industrial waste sites such as lagoons, landfill and mine tailings dam. No actual data was available during this study for these current sites. There is also no information available on other sites that may have been used for industrial waste disposal in the past. A recent study of Hornad River sediments indicate contamination with heavy metals to a great scale. A comprehensive basin wide study that addresses all possible sources of pollution and hazardous waste sites does not exist. The lack of data increases the threat of environmental liabilities.

Table A-6

Heavy Metal Concentrations in Air in ng/m^3

Number of Station/Station		Pb	Cu	Mn	Zn	Cd	Ni	V	Cr
Industrial Areas									
5	Bratislava	131	30	29	182	1.7	81	12	4
2	Horna Nitra	96	36	24	99	1.4	30	3	4
1	Hlinik n. H.	117	36	25	105	2.4	27	3	4
1	Ruzemberok	153	134	49	259	2.3	63	12	9
1	Dolny Kubin	103	98	121	149	2.1	46	5	46
1	Banska Bystrica	155	119	51	657	4.8	37	18	8
2	Kosice	189	76	63	391	3.1	40	4	10
1	**Krompachy-Richnava**	**619**	**415**	**29**	**1,294**	**12.9**	**50**	**5**	**11**
1	Strazske	72	35	16	192	1.0	46	2	6
Background Stations									
1	Chopok (2008 m)	12	11	4	68	0.9	7	0.6	0.5
1	Topolniky	56	9	21	83	1.3	18	6.1	2.6
1	Mochovce	39	7	17	79	1.1	28	3.5	1.6
1	Milhostov	57	31	16	158	3.7	50	2.8	1.5
1	Liesek	34	5	28	71	0.9	17	2.3	14.4
1	Stara Lesna	51	13	13	105	1.0	5	2.8	1.8

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Conclusions and Recommendations

Projects for control of industrial pollution sources in the Krompachy area can be prioritized on the basis of potential health risks as short term and long term. Short term projects, of course, address the highest priority needs. The following does not include prioritization of studies but rather facilities.

Short Term	Priority 1	Air Emissions Control for Kovohuty Works (Copper Smelter)
	Priority 2	Industrial Waste Treatment Facilities for Kovohuty and SEZ including sludge disposal.
Long Term	Priority 1	Remediation of Hazardous Waste Sites

The control of air emissions from the Kovohuty works has the highest priority because of its current adverse impact on the ambient quality of air and therefore potential impact on the health of all the residences of the area. Treatment facilities for the Kovohuty Works and SEZ are given lower priority relative to the significant air emissions. The water emission data for the Kovohuty Works indicate generally good current treatment by the neutralization and settling but the sludge disposal is not provided now. The quality of effluent from SEZ needs to be improved and the treatment plant being constructed should achieve this.

The remediation of hazardous wastes sites are listed under the long term project only because it does take a considerably long time to study and bring remediation. This long term classification is only general and any hazardous waste site that is found to have significant health and other environmental impact would be addressed in the short term. Studies to identify all solid/hazardous waste sites and assess their environmental impacts should have the highest priority but these studies need to be carried at a basinwide level within hydrogeologic boundaries. It is unlikely that all the hazardous waste sites in the Hornad basin could be remediated with environmental gains. The price for the past pollution has already been paid as the beneficial use of the Hornad is minimal and most of the potable water is piped from sources at unusually long distances.

Environmental Policy and Institutional Considerations

There are certain national environmental policy and institutional considerations that are potentially factors in implementing above projects. For example, uncertainties in regulatory policies on responsibilities for remediation of hazardous wastes may, for example, impact prospects of Kovohuty Works for privatization through a joint venture with a western and particularly a US company. The US companies are very conscious of environmental liabilities and need to price these liabilities before they can invest. The air emissions control project of the Kovohuty Works is currently waiting for the completion of the privatization process. Installing air quality control systems here would not be logical before the survival of the enterprise is guaranteed. However, the potential cost of cleaning the hazardous wastes that may be underlying this facility may deter many joint venture prospects. This possible connection between environmental liabilities and business decisions related to privatization needs to be assessed. Identifying extent of the hazardous waste problems would reduce the uncertainties.

In the US the responsibilities for cleanup of hazardous waste sites on industrial land has been borne by the private industry simply because the industries had been private from the very beginning. There are certain government owned industrial hazardous waste sites in the US and the government carries the liability. In the case of Slovakia, with entirely State built, owned and operated industries, the situation is quite different. Privatization of the industries also means privatization of the environmental liabilities. These liabilities are most uncertain in the case of soils and groundwater contamination with hazardous waste. In Krompachy and similar areas, the scope of studies and remediation efforts would most likely be well beyond the financial means of individual industries. Environmental policy options addressing these issues should be evaluated.

Appendix B

LANDFILLS AND LAGOONS IN KROMPACHY

Introduction

On the basis of the historical documents it may be concluded that Krompachy was already in 1282 a significant spot and one of the centers of the Spis mining and smelting industry. In the course of its 700 year history, the city has undergone a complex development in which the mines always played an important role, and mining and metal processing are continuously mentioned in all historical documents. The steel plants in Krompachy were known at the end of the 19th century, and they became the largest center of the mining and metal processing (smelting) industry in the (then) Upper Hungary.

The existing enterprises (Kovohuty and SEZ) are located in the area adjacent to Hornad river, previously wetland (due to clay layers), and later used for deposits of dross (slag, clinkers, cinders) which resulted from metal processing in the old steel plant in Krompachy.

Lagoon

The Kovohuty lagoon was established before the present water law was prepared and approved by the parliament. (The act has been valid since 1974.) At present the lagoon does not comply with the existing laws. The area of the lagoon is 23.3 thousand m^2.

The bottom of the lagoon and the dykes are of clay (compressed). This should guarantee the impermeability of the lagoon. Under the bottom of the lagoon there is a drainage system to drain the groundwater flows. The rate of groundwater discharge is monitored 12 times in a year in a monitoring shaft. According to the analyses which are available from Kovohuty, no contamination of the groundwaters has been observed.

The exact area of the lagoon is difficult to recognize due to the municipal wastes which are being deposited almost in the same area. It was not possible to obtain a map showing the exact situation and the dimension of the lagoon. The Geological Survey is carrying out monitoring of the lagoon, however they could provide us with the results only after the work is completed (in mid-1993).

The lagoon consists of three parts:

In the western part the manganese (Mn) wastes are deposited. According to information from Kovohuty, there is 130 to 135 thousand tons (kt). The production of these Mn wastes terminated in 1991. The wastes resulted from electrolytic production, and the chemical composition is the following.

Mn	-	5 - 8%
Fe	-	2 - 3%
SiO_2	-	38 - 40%
CaO	-	4 - 5%
MgO	-	5 - 6%
$(NH_4)2\ SO_4$	-	5 - 7%
Water	-	45%

It is a "special" waste. Some time ago this waste was mixed with compost and used in agriculture. At present the sludge from the slot tank is deposited here.

The middle part of the lagoon also contains manganese sludges.

The eastern part is where the copper (Cu) neutralization sludges are deposited. The production is 500-800 t/year dry matter. The total amount is estimated to be approximately 12 to 13 kt. The chemical composition is the following:

Cu	-	7 - 12%
CaO	-	23 - 34%
Ni	-	2 - 5%
Water	-	40 - 50%

At present the Cu sludges are reprocessed in Kovohuty due to the high content of Cu and Ni. In the future all of them should be processed and removed from the lagoon. The byproduct of the processing will be $CaSO_4$ x nH_2O.

In one part of the lagoon, which is separated from the others, hazardous wastes are deposited, which originate from $ZnSO_4$ production. The production of the sludge is approximately 150 - 180 t/year. The amount deposited in the lagoon is estimated to be 3 kt dry matter. The chemical composition is the following:

Zn	-	5 - 7%
Cu	-	2 - 2.5%
Fe	-	2 - 3%

Sn - 2 - 6%

Pb - 29 - 35%

Water - 50%

This sludge should be further processed; however, development is still in progress and the market is weak.

Landfill

In the SE part of the "landfill" (dump) near the new municipal WWTP there are four tanks made from concrete. These are used for the sludge which results from the production of the H_2SO_4. These tanks are practically empty.

The tank dimensions are 15m x 15m. The capacity is 2000t and transport of the sludge is by means of vans.

In the southwest part of the landfill there are two concrete tanks for the sludge resulting from the neutralization station of SEZ. The older one is full (volume app. 900m^3) and the new one is filled up to one third (volume 1200m^3). The transport frequency is 2 times a month. In the year 1991 the volume transported was 425 m^3, and in the first half of 1992 230m^3. The information on chemical composition is not available.

In the southern part of the area municipal solid wastes are deposited. The location is between the lagoon and the municipal waste water treatment plant which is under construction. The municipal solid wastes have been deposited here for a long time along with industrial and other wastes (from construction of the buildings etc.). The thickness is about 6m, however the total volume is not estimated).

In the southwest part of the landfill, used iron parts (scrap) is deposited.

In the southeast part the dross which results from production of black Cu is deposited. This black material is now processed in Slovinky (by floatation) for the Cu concentrator. A small part of the dross is used in winter time on roads for traction. The major part of these deposits have already been processed in Slovinky. The production is 25 - 30 kt/year. The chemical composition is as follows:

Cu - 0.8%

SiO2 - 32 - 35%

FeO - 28 - 32%

CuO - 6 - 10%

Other Deposits

There are additional deposits of materials from mining located between Slovinky and Krompachy. Also there is a mine tailings lagoon (located behind a 150 to 200m high dike along the road from Slovinky to Krompachy) belonging to Slovinky.

Landfills (dumps) of municipal solid waste are also observed in other places along the Hornad River downstream from Krompachy.

Additional Information Obtained

- The Cu sludge from the lagoon will be processed in the future and new sludge will not be produced.
- The gypsum resulting from Cu processing could be used in the building industry.
- New Mn sludge will not be produced in the future due to change in the production program of the factory.
- A problem which will remain in the future is the Zn sludge, because production will continue.
- The sludge from the new neutralization station of SEZ (to be put in operation this year) will be taken away and subsequently processed by the supplier of the new neutralization station.
- The barren material deposits are located in the area between Slovinky and Krompachy (from old mines in Slovinky).
- There is also near Slovinky an old ore processing/tailings lagoon with a collapsed dike. Nowadays it is not used.
- The municipal solid wastes after segregation (separation) may be deposited in a controlled landfill to be constructed in Spisske Vlachy. The existing landfill will then have to be cleaned up.
- The whole area where the landfill and lagoon are located is being surveyed and monitored by the Geological Survey a/s Company in Spisska Nova Ves. Their report with results will be available in June 1993.
- According to the urban plan of Krompachy, the city and the surrounding area should be rehabilitated and utilized for tourism and recreation (e.g. skiing).

Appendix C

ANALYSIS OF MUNICIPAL EMISSIONS

Population Projections

1. Population projections provide the basis for any analysis of municipal emissions. Such projections when combined with per capita emission rates and development trends provide the most reliable basis for estimating future quantities and rates of emission for residential and institutional sources.

2. The residential (and institutional) population of Krompachy climbed during the 1970's and 80's to a high of 8,241 (including gypsies) in 1991. Since that time population has begun to decline in response to a weakening economic climate and changing markets. The development of a downhill ski area about 3 km southeast of Krompachy is now occurring and may have some positive impact on the economic climate in the future especially if it becomes a year-round destination resort. However, this development is still in its infancy and is not expected to significantly alter present trends in the foreseeable future. Thus the future population of Krompachy city is expected to remain at about 8,200 people.

   For new development to occur the city believes the following are needed:

   - New wastewater treatment plant - under construction
   - Improved municipal landfill
   - More drinking water

3. Planning of the new municipal wastewater treatment plant has included provision for two adjacent villages with the following populations:

	Existing	2020
Slovinky Village	1,800	2,280
Kolinovce Village	512	320

   Each of these villages is presently served by septic systems. Near Slovinky the sanitary wastewaters from about 500 persons are treated in a slot tank (open septic tank) before discharge to Slovinky Creek.

4. The projected residential population of the proposed project area is as follows:

	Present	Future (2020)
Krompachy	8,241	8,200
2 Villages	2,312	2,600
	10,553	10,800

Municipal Wastewater Analysis

5. The projection of future flows of wastewater is in addition to population, related closely to the projection of drinking water consumption. The consumption of water commonly approximates sewage flow in the absence of extensive yard and garden usage. This apparent equality exists in Krompachy where the average water production in 1990 (latest year available) was 44.78 L/s. Maximum production was 56.12 L/s.

6. The Krompachy water supply is taken from 5 sources shown on maps Figures 1 and 2 and listed below with their 1990 flows:

1990 Flow, L/s

Source	Minimum	Maximum	Average
Intake from Lacemberk Creek	NA	21.07	21.07
Well - Stara Masa*	NA	1.84	1.84
Well - Hydro Power Station	NA	1.31	1.31
3 Springs in Porac Valley	9.90	31.90	20.54
3 Springs in Krompachy East	NA	NA	Negligible
Totals	34.12	56.12	44.78

* Used only for 5 to 20 days per year in an emergency only.

NA - no information available

7. During dry summer periods, demand often exceeds the production capacity of these sources. At these times spring yields drop, and residents are asked to conserve water. Summer deficits amount to 15 to 17 L/s. Slovinky village takes between 5.8 and 7.7 L/s of water from the transmission main before it reaches Krompachy. The estimated per capita water consumption of Slovinky village is about twice that of Krompachy.

8. The city is pursuing three possible options to augment their water supply:

   - A regional supply system with water coming from Spisske Vlachy has been proposed.

   - Supplies from nearby valleys have been studied by the Geological Survey but results are inconclusive, and funding for more studies is needed.

- Supplies from another basin to provide water particularly for the ski area are needed, but the amount of water available is not known.

9. The quality of water supplied from the above sources is indicated to be generally good for chemical and biological parameters. The exception is the well (6 to 8 meters deep) at Stara Masa for which limits were exceeded in 1990 as follows:

Ammonia (NH_4)	-	1.65 mg/L max vs. 0.5 limit
Manganese (Mn)	-	1.30 mg/L max vs. 0.1 limit
Nitrite (NO_2)	-	0.11 mg/L max vs. 0.1 limit

The surface supply at Lacemberk Creek receives treatment by filtration and chlorination before entering the transmission main to Krompachy via Slovinky village.

Heavy metals concentrations measured at several points in the Krompachy water system are shown in Table 1.

10. A listing of point sources of water pollution in Krompachy is shown in Table 2. There are 10 point sources of which 4 are connected to the municipal sewer system before discharging to the river or creek. The other 6 sources discharge directly to the streams. Sanitary wastewaters and kitchen wastes from Kovohuty (copper smelter) and SEZ (electrical components plant) are treated in "slot tanks" (open septic tanks) before discharge. Sewage from the hospital now passes through a WWTP which is planned for abandonment.

An estimate of average sanitary wastewater flows from residential, institutional and industrial sources shows the following for 1990, the latest year for which municipal information is available.

4 Municipal Outlets	18.2 L/s
Hospital	4.1
Transit Company and VSE	0.5
Kovohuty*	3.7
SEZ*	4.6
Total	31.1 L/s

*100% of 1992 domestic water consumption

11. A projection of future sanitary wastewater flows for Krompachy and vicinity is shown on Figure 3. It shows that average daily flows with all 3 communities fully connected to the sewerage network will reach only about 71 percent of the initial average daily design capacity of the WWTP by the year 2020. If the population of Krompachy does not grow as envisioned in the WWTP design, industrial sanitary wastewaters remain the same as at present and Slovinky and Kolinovce villages are not connected to the Krompachy sewerage network, average dry weather flows will be less than half the design flow. This latter scenario appears to be more realistic than that contemplated in the present design.

Municipal Wastewater Treatment Plant

12. The Krompachy municipal WWTP is now about 75 percent complete with most of the remaining work to involve equipment purchase and installation, site work, landscaping and contractor demobilization. The WWTP design flows are:

Average dry weather	-	64.6 L/s
Minimum dry weather	-	41.9 L/s
Maximum treatment capacity	-	129.2 L/s
Maximum rainstorm capacity	-	429.0 L/s

It is designed for a 2020 population equivalent of 21,926, an average of 255 L/capita/day.

The WWTP is intended to receive wet weather flows of up to 429 L/s or about 7 times dry weather flow. However flows above 129.2 L/s will enter storm water storage tanks to capture the assumed "first flush" of pollutants. Excess flows are to be bypassed directly to the river.

13. The Krompachy WWTP is essentially an extended aeration plant without primary settling tanks. It is designed to remove over 90 percent of the BOD_5 and suspended solids (SS), but it is not designed to remove inorganics and heavy metals. At average design flow the detention time in the aeration basins is about 17.4 hours. At maximum flow the detention time is about 8.7 hours. It appears therefore that the design is quite conservative in that the aeration will have estimated detention times of 24 to 29 hours for projected 2020 average flow. Furthermore the design and construction of a mechanical (primary settling) treatment plant for Krompachy would have been sufficient to protect the Hornad River in light of other water pollution sources in the area.

14. A process schematic diagram for the Krompachy WWTP is shown on Figure 4. Major process units are listed in Table 3.

15. No site for disposal of the sludge produced by the WWTP has been finally determined. If the heavy metals content is within acceptable limits, one farm may be willing to accept it. However, WWTP design did not determine influent flow characteristics or content (by flow gaging and sampling). Because the sewerage network is combined and storm water runoff carries slag containing heavy metals, the quality of the sludge may not be acceptable for land application even if pretreated industrial wastewaters are not received at the WWTP. It appears that because of this uncertainty, a large thickened sludge storage tank has been provided, but this tank does not provide a long-term answer for sludge disposal or utilization.

16. The construction of the Krompachy WWTP is estimated to be about 75 percent complete based on visual observation, discussion with the design engineer and analysis of expenditures and claims to date. It is estimated that the total cost to construct the WWTP to the existing design and using existing methods would be about $US 5.78 million at mid-1993 prices. Of this amount about US$1.31 million remains to be spent. At this time

80 to 85 percent of the structural work is complete. No equipment installation has begun. The belt filter press has been purchased and is stored at the site.

17. The estimated construction cost for the 64.6 L/s (about 1.5mgd) WWTP is $US 5.78 million or about $US 4.00 per gpd (gallon per day) of capacity. This cost is on a par with costs for advanced secondary WWTP's in the US despite a better than 5:1 difference in labor rates. It is concluded that the construction cost of the 64.6 L/s Krompachy WWTP is approximately twice what it should be using modern construction practices.

Krompachy Main Trunk Sewer

18. The new Main Trunk Sewer is estimated to be about 20 to 25 percent complete based on observation of construction and discussion with the design engineer. It has a total length of about 3.1 km and terminates at the new municipal WWTP. Approximately 700m of this trunk sewer is designed as tunnel with the remainder for open cut construction.

19. The diameter of the trunk sewer varies from 800 mm to 1.4m in diameter, and the pipe is heavy walled unreinforced concrete without preformed gasket joints. For this project extra strength reinforced concrete pipe should be used inasmuch as the sewer is laid close to the surface for much of its length and there is considerable truck traffic especially in the industrial area. Pipe bedding and backfilling appeared to be inadequate to provide proper pipe support under the observed conditions.

20. The trunk sewer size is based on a standard ratio of 7 times dry weather flow to provide storm flow carrying capacity. However it is clear that a lower ratio would be sufficient because more frequent overflows of mixed sewage and stormwater would have minimal impact on either Slovinky Creek or the Hornad River. A ratio of 3 or 4 times dry weather flow is commonly used. Thus the size of the main trunk sewer is greater than is required.

21. The trunk sewer tunnel portion involves the use of a 1.6 m diameter shield and a tunneling machine to bore into the fractured rock (schist). This method is extremely expensive. Exact progress of the tunnel construction is not known, but if it is not too advanced, consideration should be given to stopping it and proceeding with a less expensive alternative.

22. It is estimated that the construction cost of the tunnel section represents about 66 percent of the total cost of trunk sewer construction which is estimated at about $US 3.93 million at mid- 1993 cost levels. The unit cost of the tunnel construction is about $US 1,130 per lineal foot (l.f.) compared with less than $170 per l.f. for the open cut construction.

23. It is estimated that about $US 5.00 million (1.3 + 3.7) will be needed to complete the construction of the WWTP and main trunk sewer as currently planned and designed. About 20 million SK ($US .070) is expected to come from the VVAK in 1993, and local funds are not available. At this rate of expenditure the project will never be completed since construction cost escalation is running at about 25 percent annually.

Sewerage Network

24. As part of the design work performed by Hidrocounsult on the main trunk sewer and WWTP, a visual inspection of the existing Krompachy sewerage network was made at accessible points in 1988. Photography and video inspection were not performed to determine the physical condition of the system. Some sewers are known to be over 50 years old.

25. As a result of the inspection the following conclusions were drawn:

Existing Sewers	
In Satisfactory condition	3,766m
Needing reconstruction	4,935m
Sewer Extensions Needed	8,393m

26. The existing sewerage network is a combined system which collects both sanitary sewage and storm water. As a result pipe sizes are much larger than would be required for sanitary sewage (from residences and institutions) alone.

27. The design of the municipal WWTP includes allowances for sanitary wastewater from the two neighboring villages of Slovinky and Kolinovce. To connect Slovinky with the Krompachy system will require a connecting main about 3 km in length, and to connect Kolinovce a connecting main about 0.8 km long will be required. Neither village has a municipal sewer system, but Slovinky is supplied with public water.

28. About 98 percent of the population of Krompachy is connected to the existing sewerage network through 347 connections. There are an estimated 789 buildings (houses, flat blocks and institutions) and therefore 442 building connections are required. In addition, the hospital WWTP is to be abandoned and connection made with the municipal sewer system. It is reported that all flatblocks are now connected.

29. For Slovinky it is estimated that about 570 household connections would be required. For Kolinovce about 130 connections would be required.

30. At present there is no mechanism in place to require homeowners and others to connect to the municipal sewer system.

Municipal Solid Waste Management

31. A description of the landfills and lagoons in the Krompachy area is presented in Annex 1. From this description and from field inspection both the landfills and lagoons are uncontrolled open dumps which discharge leachate and runoff to nearby streams.

32. The Krompachy municipal solid waste dump is located on the same site as the metal sludge lagoons which receive wastes from the copper smelter and electrical components plant. It is located immediately adjacent to the Hornad River as shown on Figure 2 and therefore is a potentially significant pollution source. Results from a Geological Survey study are not available.

33. Municipal solid waste is now collected regionally and deposited in landfills located in Krompachy and Spisske Vlachy. Six villages now dump their wastes in Krompachy under a contract with Krompachy City. Annual operating costs for the Krompachy landfill are reported to be about 1.1 million Sk.

34. Negotiations are now underway between Krompachy and Spisske Vlachy for Krompachy to participate in a new regional landfill to be located at an abandoned clay mine in Spisske Vlachy. It is reportedly able to meet disposal requirements for the next 50 years. The Krompachy City Council has recommended taking their solid waste to Spisske Vlachy.

35. It is anticipated that as part of the new regional disposal operation, solid waste would be separated by the individual communities. In Spisska Nova Ves an Austrian firm may be operating or planning to operate a MRF (materials recovery facility). Krompachy would like to use this technology also.

Appendix D

MUNICIPAL TECHNICAL ISSUES

1. Cost of the Krompachy WWTP

   There is need for an efficient well-operated municipal WWTP to alleviate organic pollution and bacterial contamination of the Hornad River and upstream portions of Ruzin Reservoir where water contact recreational activities now occur in summer. Unfortunately, the 64.6 L/s WWTP currently under construction is far larger than is needed for the foreseeable future. Its budgeted cost (about $US 5.8 million) is comparable to advanced secondary treatment plant costs in the U.S. where construction labor costs are many times higher. It is estimated that by using standard western construction practices the cost of the Krompachy WWTP should be no more than half the budgeted cost. Furthermore, it is estimated that a 65 L/s package treatment plant available in Slovakia would cost about 40 million Sk or $US 1.4 million. Clearly, the present WWTP design is not cost effective.

2. Cost of the Main Trunk Sewer

   A new main trunk sewer such as that now under construction is essential to bring municipal wastewaters to the new WWTP. However it is larger and more expensive than it needs to be. It is designed to carry stormwater flows of about 7 times the design dry weather flow of 64.6 L/s (423.1 L/s) in order to capture the "first flush" of organic loading for 30 minutes during storm events. The first flush phenomenon has been debated in professional engineering circles for decades; it is a phenomenon often not observed. In the case of Krompachy no sewer gagings or other measurements of sewage characteristics were performed to provide a design basis or demonstrate the existence of a first flush in Krompachy. A more cost effective approach would be to design the trunk sewer for, say, 3 times a more likely future average dry weather flow rate of about 40 L/s (120 L/s). Such a design flow would yield an average trunk sewer diameter of about 540 mm instead of 1 meter and reduce construction costs by about half. The impact of reducing the main trunk size would be to increase the frequency of storm overflow events, but in view of the more serious pollution emanating from other sources and the diluting effect of storm water, such impact would be minimal. In conclusion, it is suggested that the design of the main trunk sewer be re-examined before construction proceeds further.

3. Tunnel Portion of Main Trunk Sewer

   About 700 m of the total 3.1 km length of the Krompachy Main Trunk Sewer is planned to be constructed in tunnel. This relatively short length of tunnel construction is estimated to represent almost 70 percent of the total sewer cost. The cost effectiveness of tunnel construction vs. other methods of crossing difficult areas (such as pumping via force main or inverted siphon) should be examined before construction of the tunnel proceeds further. Tunnel boring reportedly is just starting.

4. Connections to the Krompachy Sewerage Network

   It is estimated that 98 percent of the residents of Krompachy are served by the existing sewerage network. This figure is misleading, however, inasmuch as only 347 connections to the sewerage network exist while there are about 789 buildings (including residences, flat blocks, institutions, shops, etc.). In addition, portions of the existing network are not interconnected, with the result that sewage discharges occur into the storm drainage channels.

5. Use of Hazardous Material on Streets

   It is understood that slag from the Kovohuty Krompachy copper smelter is used on streets to provide traction in the winter. This practice should be halted as soon as possible, in any event, before the new WWTP is placed in operation. The slag reportedly contains high amounts of various heavy metals, which enters the sewerage network during rainstorms. Continuation of this practice may prevent the safe utilization of WWTP sludge and create a sludge disposal problem.

6. Utilization of Wastewater Sludge

   The utilization of wastewater sludge through application on agricultural lands is attractive. There is concern, however, that land application of sludge from Krompachy may not be possible if heavy metals content is too high. By improving the quality of sludge, assuring its consistent high quality, improving land application techniques and educating potential users to its value and safety, sludge from the Krompachy WWTP can and should be land applied. Its nutrient content and its value as a soil conditioner can help maintain soil productivity and also reclaim marginally productive land.

7. Wastewater Collection System Operation and Maintenance

   The proper operation of a municipal WWTP such as the Krompachy WWTP depends heavily on the proper functioning of its tributary collection system. Indeed, the WWTP and collection system are integral parts of one system to collect, convey, treat and discharge flows of acceptable quality into nearby water courses. The provision of sufficient sewer maintenance equipment, vehicles and supplies is needed along with effective management to not only assure prompt, effective response to problems as they arise, but also to provide preventive maintenance. A collection systems O&M specialist should review existing facilities, procedures and training equipment and recommend improvements for the Krompachy system.

8. Extension of the Municipal Sewerage Network

   Currently there are several areas in Krompachy which are unsewered or discharge into local waterways passing through residential areas. For public health reasons it is essential

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that all buildings from which sanitary sewage is discharged be connected to the sewerage network and that the network be extended to do this.

9. Connection of Buildings to the Sewerage Network in Krompachy

It is reported that there is now no mechanism in place which requires a resident to connect household plumbing with the sewage network. Such a mechanism is essential to assure that the network, main trunk sewer and municipal WWTP all receive the flows they are designed for. Investments in new construction will be effective only to the extent connections are made.

10. Industrial Wastewaters from SEZ

The SEZ electrical components plant is now constructing a treatment facility for its galvanizing and electro-plating wastewaters. These wastewaters are inorganic and toxic in nature, and when introduced into municipal WWTP's, they interfere with biological treatment and contaminate the resulting sludge product, potentially rendering it unacceptable for agricultural land application. For these reasons the industrial wastewaters from SEZ should be appropriately treated and discharged directly to the Hornad River.

11. Construction Cost Escalation

The rate of increase in construction costs in Slovakia has been between 30 and 40 percent per year for the past several years and now appears to be in the 25 to 30 percent range. This escalation has profound impact on the construction of WWTP's trunk sewers and associated facilities. It has delayed completion or stopped many WWTP construction projects in Slovakia including the Krompachy facilities since costs exceed budgets. This situation is compounded in Krompachy by the oversizing of facilities as discussed above and the delays induced by the recent change in policy from a requirement to buy from the East to looking at Western technology. Continuing delays in the completion of the Krompachy WWTP and Main Trunk Sewer are increasing the construction costs presented in this report at a rapid rate. At current rates of escalation, progress and funding, construction will never be completed.

12. High Cost of Construction Projects

A comparative evaluation of the total construction costs of the Krompachy WWTP and Main Trunk Sewer has been made. It was found that costs in Slovakia are about equal to those in the U.S. despite a wide disparity in labor costs. Precise causes for this situation are not known but are believed to stem from the continuing practice of centralized state planning, design and construction. With the introduction of competition and private enterprise into the construction market, costs in Slovakia should approach a level more consistent with labor rates.

13. <u>Need for Watershed Planning</u>

In the United States the 1972 Clean Water Act was significant in many respects, but one of the most significant was its requirement for area wide watershed (basin or sub-basin) planning. Watersheds are the logical hydrologic unit within which to plan, implement and evaluate pollution prevention efforts. Improved capabilities to monitor and model watersheds now can enable officials to effectively plan and make informed decisions on allocating limited funds; for example, to decide whether funds would best be spent to build new municipal WWTP's, implement modern industrial waste pollution control measures, remediate solid and hazardous waste dumps or to integrate all of these activities into one comprehensive program. Watershed planning using state-of-the-art methods should be implemented by the PBaH. These planning activities should include:

- increased water and air quality monitoring
- development of management plans based on modern modelling techniques
- setting priorities regarding compliance schedules
- cost-effectiveness analyses
- establishing resource allocations in conformance with priorities and cost-effectiveness for various sources of impairment in the watershed

The development of a model watershed project in the upper Hornad watershed (above Mala Lodina) in Slovakia is greatly needed.